ALPHABETICAL LIST OF MODULES IN THE FACULTY OF NATURAL AND AGRICULTURAL SCIENCES

 # = Concurrent registration
() = Examination admission
dpw = discussions per week
GS = combined (final) mark (semester/year mark plus examination mark) of at least 40% - 49%
hpw = hours per week
LP = Lecturer's permission
lpw = lectures per week
ppw = practicals per week
spw = seminars per week
TDH = Permission by head of department
tpw = tutorials per week

AGR 313 Primary food crops 313
Academic organisation: Plant Production and Soil Science
Prerequisite: HSC 260 and PPK 251
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
The cultivation of important vegetables including tomatoes, the cucurbits, the cabbage family and onions. Botanical characteristics, classification, growth requirements, production practices and utilisation of vegetables in the field and in a controlled environment. Visits to fresh produce markets, seed and chemical companies and growers.

AGR 361 Field crops 361
Academic organisation: Plant Production and Soil Science
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
Botanical characteristics, classification, growth requirements, production practices and utilization of crops rich in starch, oil and protein, fibre crops, tobacco, sugarcane and medicinal plants. Visits to research institutions and producers.

AGR 410 Vegetable crops 410
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
Integration of agronomic, pedological, botanical, economic and management considerations in crop production systems with a view to sustainable maximum economic yield. Case studies of specific crops.

AGV 412 Group dynamics, leadership and communication factors 412
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 3 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Community - concept and meaning; the community and change; hindrances to change. The use of small groups in the community; group dynamics; group and community goals. The paradigm shift from directing to facilitating; group techniques; participative techniques. Leadership development in communities. Case studies.

AGV 413 Communication 413
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: Health Sciences students: second year status
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Nature and importance of development communication; the process and models of communication; critical elements and factors in communication; symbol systems and non-verbal communication. Credibility, messages and message treatment; audience and audience identification; channels and methods of communication. Effective listening and feedback. Practical training in communication: Effective speaking; visual aids in communication; managing conflict; report writing.

AGV 415 Principles and approaches of development and extension 415
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
The role, importance and nature of extension and development; ethics in development and extension. International approaches to development and extension; paradigm shifts within extension and development. The Third World: concept, characteristics and change. The subsistence farmer, rural poverty and the deprivation trap. Development practice and theories. Participation; appropriate technology; role players and responsibilities in development.

AGV 421 Communication 421
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 20
Module content:
Communication: Definition and clarification of concepts. Theory and elements of communication. Verbal and non-verbal communication. Determinants of interpersonal communication. Abating factors impeding communication. Nature, classification and efficiency of communication channels.

AGV 426 Programme and project planning 426
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Nature, purpose and principles of a programmed and purposeful approach. Institutional framework for community participation, ownership and empowerment; linking with complementary and support services. Participative need appraisal, problem identification and delimitation; PRA methods and techniques; problem conceptualisation and development of survey instrument; situation surveys and analyses; formulation of objectives; identification and scheduling of methods and activities; work plan or calendar construction, budgeting.

AGV 428 Evaluation of development and development projects 428
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Reasons and purposes of evaluation; expectations from evaluations; role players and motives in evaluation. Criteria and indicators of development, development projects and development organisations.
Methods of evaluation; formulation of objectives and scale construction for evaluation; developing and coding the measuring instrument. Sampling and sampling techniques; data analysis and interpretation; evaluation report.

AGV 429 Behaviour change and intervention 429
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Characteristics of human behaviour; basic concepts: perception, defence mechanism, decision making and problem solving, learning, innovativeness and adoption behaviour; diffusion of innovations: elements and phases of diffusion, opinion leaders and contact farmers, methodological implications for extension. Psychological, cultural and social barriers to change. Behaviour change or modification: comparison of different approaches and strategies. A practical model: background principles and theories, identifying “forces” or behaviour determinants; designing effective extension messages for development programmes.

APS 461 Crop physiology 461
Academic organisation: Plant Production and Soil Science
Prerequisite: GKD 250 and BOT 356
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 14
Module content:
An overview of photosynthesis and respiration, with the aim of examining the physiological basis of yield in cropping systems. This includes an assessment of parameters for determining plant growth, factors governing yield, partitioning of

photoassimilates within plants and opportunities for increasing yield. Crop growth and yield will be put into context of a changing global climate. Evaluation of the manner in which plants respond to various abiotic stresses and how plants sense changing environments. The various roles of plant growth regulators in plants and the importance of these compounds in agriculture.

APZ 325 Livestock breeding 325
Academic organisation: Animal and Wildlife Sciences
Prerequisite: GTS 261
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Introduction to applied animal breeding and genetics: Genetic defects in farm and companion animals (single gene and multifactor characteristics). Phenotypic expression of genes in qualitative and quantitative inheritance. Principles of breeding and selecting farm and companion animals, breeding systems, application and interpretation of breeding values and animal recording schemes.

ARD 480 Agriculture and rural development studies 480
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 3 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 40
Module content:
Overview of the concepts and theories of rural development; the role of agriculture in rural development. Rural livelihood systems: household farming systems; decisions and the operation of farming systems; non-farm enterprises and SMMEs in the rural economy; household food security. Rural institutions: definitions and role of institutions; land tenure; rural financial markets; local institutional development; human capital, knowledge systems. Methodologies for rural development: the farming systems approach; participatory techniques; assessment of land use patterns (zoning techniques); typology techniques; technology transfer and decision-making support; communication for rural development; planning rural development at local level.

ARD 482 Resources and development 482
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Review of the most important physical-biological agricultural resources - soil, water, climate, topography, plant species, animal species; differences in characteristics, quality and vulnerability; the concept of optimum land use; resource conservation; general ecological principles; examples of problems caused by mismatching of physical-biological resources and land use during development planning; principles of sensible technology transfer.

BCM 253 Introduction to proteins and enzymes 253
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 254 #, CMY 117 GS, CMY 127 GS and MLB 111 GS; Health Sciences students: MLB 111 GS
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 9
Module content:
Structural and ionic properties of amino acids. Peptides, the peptide bond, primary, secondary, tertiary and quaternary structure of proteins. Interactions that stabilize protein structure, denaturation and renaturation of proteins. Introduction to methods for the purification of proteins, amino acid composition, and sequence determinations. Introduction to enzyme kinetics and enzyme inhibition. Allosteric enzymes, regulation of enzyme activity, active centres and mechanisms of enzyme catalysis. Examples of industrial applications of enzymes.

BCM 254 Practical: Introduction to proteins and enzymes 254
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 253 #, CMY 117 GS, CMY 127 GS and MLB 111 GS; Health Sciences students: CMY 117 GS and CMY 127 GS
Contact time: 0.5ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 3
Module content:
Laboratory techniques and Good Laboratory Practice. Techniques for the quantitative and qualitative analysis of biological molecules. Processing and presentation of scientific data.

BCM 255 Carbohydrate metabolism 255
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 256 #, CMY 117 GS, CMY 127 GS and MLB 111 GS; Health Sciences students: MLB 111
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 9
Module content:
Biochemistry of carbohydrates. Thermodynamics and bioenergetics. Glycolysis, citric acid cycle and electron transport. Glycogen metabolism, pentose-phosphate pathway, gluconeogenesis and photosynthesis.

BCM 256 Practical: Carbohydrate metabolism 256
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 255 #, CMY 117 GS, CMY 127 GS and MLB 111 GS
Health Sciences students: CMY 117 GS and CMY 127 GS
Contact time: 0.5ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 3
Module content:
Study and analysis of metabolic pathways and enzymes. Scientific method and design: hypothesis design and testing, method design and scientific controls.

BCM 263 Lipid and nitrogen metabolism 263
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 264 #, CMY 117 GS, CMY 127 GS and MLB 111 GS; Health Sciences students: BCM 253 GS, BCM 254 GS, BCM 255 GS and BCM 256 GS
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 9
Module content:
Biochemistry of lipids, membrane structure, anabolism and catabolism of lipids. Nitrogen metabolism, amino acid biosynthesis and catabolism. Biosynthesis of neurotransmitters, pigments, hormones and nucleotides from amino acids. Catabolism of pureness and pyrimidines. Therapeutic agents directed against nucleotide metabolism. Examples of in-born errors of metabolism of nitrogen containing compounds. The urea cycle, nitrogen excretion.

BCM 264 Practical: Lipid and nitrogen metabolism 264
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 263 #, CMY 117 GS, CMY 127 GS and MLB 111 GS
Health Sciences students: BCM 253 GS, BCM 254 GS, BCM 255 GS and BCM 256 GS
Contact time: 0.5ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 3
Module content:
Scientific writing skills: evaluation of a scientific report. Techniques for separation and analysis of biological molecules.

BCM 265 Biochemistry in perspective 265
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 266 #, CMY 117 GS, CMY127 GS and MLB 111 GS; Health Sciences students: BCM 253 GS, BCM 254 GS, BCM 255 GS and BCM 256 GS
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 9
Module content:
Integration of metabolic pathways; biochemistry of nutrition and xenobiochemistry; hormones and second messengers; hormonal control in metabolism, a case study in connectivity among metabolic pathways, nutrition, regulation and the immune system.

BCM 266 Practical: Biochemistry in perspective 266
Academic organisation: Biochemistry
Prerequisite: Natural and Agricultural Sciences students: BCM 265 #, CMY 117 GS, CMY 127 GS and MLB 111 GS; Health Sciences students: BCM 253 GS, BCM 254 GS, BCM 255 GS and BCM 256 GS
Contact time: 0.5ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 3

Module content:
Study of structure-function relationships and biological activity. Critical evaluation of results and identification of patterns or tendencies in observations.

BCM 271 Biochemistry practical 271
Academic organisation: Biochemistry
Prerequisite: [BCM 253 and BCM 254] and [BCM 255 and BCM 256] and [BCM 263 and BCM 264] and [BCM 265 and BCM 266] and CMY 283 and CMY 284
Contact time: 1 ppw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
*Note: for students majoring in biochemistry only Basic biochemical separation methods, experimental design, biochemical calculations.

BCM 351 Biochemistry of proteins 351
Academic organisation: Biochemistry
Prerequisite: BCM 253 and BCM 254
Contact time: 2 lpw 1 ppw
Period of presentation: Quarter 1
Language of tuition: Double Medium **Credits:** 9
Module content:
Biochemistry of amino acids, peptides and proteins. Chemical modification of amino acids. Primary, secondary, tertiary and quaternary structure, protein folding, sequence motifs and domains, supersecondary and supramolecular structure, self assembly. Practical: subcellular fractionation (CBE) and purification of proteins. HPLC of proteins (CBE). Dipeptide sequencing and electrophoresis of proteins.

BCM 352 Proteome analysis 352
Academic organisation: Biochemistry
Prerequisite: BCM 253, BCM 254 and BCM 351 GS
Contact time: 2 lpw 1 ppw
Period of presentation: Quarter 2
Language of tuition: Double Medium **Credits:** 9
Module content:
Analysis of amino acid composition and sequence of proteins. Isolation and characterisation of proteins. Introduction to proteomics. Sequence-based characterisation of proteins, scoring matrices and algorithms. Basic techniques for three-dimensional modelling and characterisation. Practical: introduction to bioinformatics in protein structure-function relation investigations.

BCM 354 Biochemistry of nucleic acids 354
Academic organisation: Biochemistry
Prerequisite: [BCM 253 and BCM 254] and [BCM 255 and BCM 256] and [BCM 263 and BCM 264] and [BCM 265 and BCM 266]
Contact time: 0.5ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 9
Module content:
Biochemistry of nucleic acids, nucleotides and nitrogen bases. Chemical and enzymatic methods for studying nucleic acid structure. Primary, secondary and tertiary structure of nucleic acids and sequence-induced conformational types, DNA enzymes.

Chemical modification of nucleotides and nucleic acids and in vivo repair mechanisms. Application of sequence-specific modifications in drug design and antigene approaches. Sequence and structure-specific interactions between small ligands (dyes and antibiotics) and nucleic acids. Fundamentals of RNA structure; application of principles to understand ribozymes, gene silencing, ribosomes and protein translation. Interaction between nucleic acids and nucleic acids binding proteins, the role of DNA shape in protein-DNA recognition and the biochemical principles of gene regulation.

BCM 355 Immunobiology 355
Academic organisation: Biochemistry
Prerequisite: [BCM 253 and BCM 254] and [BCM 255 and BCM 256] and [BCM 263 and BCM 264] and [BCM 265 and BCM 266]
Contact time: 0.5ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 9
Module content:
Adaptive and innate immunity. Complement. Organs and cells of the immune response. Cell killing: phagocytosis, apoptosis and necrosis. Anatomy and ontogeny (development) of the immune system. Chemical and cellular techniques of immunology. The origin of diversity in antigen receptors. Practical: working with experimental animals, the synthesis of hapten-protein conjugate, immunisation, bleeding and serum production and an immuno-assay.

BCM 362 Nutritional biochemistry 362
Academic organisation: Biochemistry
Prerequisite: BCM265
Contact time: 1 lpw
Period of presentation: Quarter 3
Language of tuition: Double Medium **Credits:** 4
Module content:
Proximate analysis of nutrients. Review of energy requirements and expenditure. Metabolism of energy-yielding nutrients. Requirements and function of water, vitamins and minerals. Interpretation and modification of RDA values for specific diets, eg growth, exercise, pregnancy and lactation, aging and starvation. Comparison of monogastric and ruminant species. Composition of triglycerides, fatty acids and arteriosclerosis. Cholesterol, polyunsaturated, essential fatty acids and dietary antioxidants. Interactions between nutrients. Biochemical functions of water and fat-soluble vitamins and assessment of vitamin status. Mineral requirements, biochemical function, imbalances and diarrhea.

BCM 363 Xeno biochemistry 363
Academic organisation: Biochemistry
Prerequisite: BCM265
Contact time: 1 lpw
Period of presentation: Quarter 4
Language of tuition: Double Medium **Credits:** 5
Module content:
Metabolism of xenobiotics: absorption, distribution, metabolism and excretion; oxidation/reduction (Phase I), conjugations (Phase II), export from cells (Phase III); factors affecting metabolism and disposition. Toxic responses: tissue damage and physiological effects; teratogenesis, immunotoxicity, mutagenesis and carcinogenesis. Examples of toxins: biochemical mechanisms of common toxins and their antidotes.

BCM 364 Building the cell 364
Academic organisation: Biochemistry
Contact time: 1 lpw 0.5ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 9
Module content:
Membrane structure: plasma membrane structure, organisation of lipid membranes, membrane proteins, glycoproteins and glycolipids, principles of membrane organisation (cytoskeletal components), specialisations of the plasma membrane (neuronal tissue). Transport across cell membranes: major types of membrane transport proteins; diffusion of small molecules across pure phospholipid bilayers; uniporter-catalysed transport of specific molecules; ion channels, intracellular ion environment and membrane electric potential; active ion transport and ATP hydrolysis; cotransport catalysed by symporters and antiporters; osmosis, water channels and the regulation of cell volume. Calculation of free energy change during transport. Synthesis and sorting of plasma membrane, secretory and lysosomal proteins. Protein modifications, folding and quality control in the ER, further glycoprotein processing in the Golgi. Vesicular traffic, protein secretion and endocytosis. Introduction to signaling: G-proteins, adenylyl cyclase, phospholipase C and secondary messenger molecules (cyclic AMP, calcium and inositol-triphosphates).

BCM 365 Immunobiochemistry 365
Academic organisation: Biochemistry
Prerequisite: BCM 355 GS
Contact time: 0.5ppw 1 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 9
Module content:
Interactions between antigens and antibodies: quantitative and qualitative properties, regulation of the immune response, integrated immunology. Practical: tutorials on integrated and quantitative immunology.

BCM 366 Enzymology 366
Academic organisation: Biochemistry
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 9
Module content:
Nomenclature: enzyme nomenclature and classification. Specificity and mechanisms: the active site, mechanisms of catalysis and examples of specific enzyme mechanisms e.g. lysozyme and carboxypeptidase A. Enzyme kinetics: derivation of Michaelis-Menten (MM) equation by equilibrium and steady state assumptions, significance of Km and Vmax in the catalytic efficiency of enzymes and linear transformations of the MM equation. Enzyme inhibition: competitive, uncompetitive, non-competitive and irreversible inhibitors with examples of specific toxins and drugs. Multi-substrates: Cleland nomenclature and multisubstrate reactions. Allosteric enzymes: models by Koshland, Hill and Monod. Problems and answers: tutorials of problems and answers based on above concepts. Practicals: isolation of an enzyme, determination of pH and temperature optimum, determination of Km and Vmax, enzyme activation, enzyme inhibition, purification table and final report, oral defense of report.

BIF 311 Bioinformatics 311
Academic organisation: Biochemistry
Prerequisite: WTW114 OR WTW134 and BME120 and GTS251 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Concepts in biological sequence analysis. Biological data structures. Deriving and using scoring matrices. Theory and application of sequence alignment algorithms. Nucleic acid feature analysis and prediction methods. Protein feature analysis and prediction methods. Pattern recognition. Protein structure prediction concepts and methods. Intermolecular interaction and biological pathway analysis. Introductory microarray data analysis. Phylogenomics. Common algorithms in bioinformatics. Introductory statistics for bioinformatics. Programming for bioinformatics.

BOT 161 Plant biology 161
Academic organisation: Plant Science
Prerequisite: MLB 111 GS
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Basic plant structure and function; introductory plant taxonomy and plant systematics; principles of plant molecular biology and applications of plant molecular tools; the ecosystem; adaptation of plants to extreme environments; medicinal compounds from plants; introduction to veld evaluation and veld management.

BOT 251 South African flora and vegetation 251
Academic organisation: Plant Science
Prerequisite: BOT 161 or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Origin and affinity of South African flora and vegetation types; principles of plant geography; plant diversity in southern Africa; characteristics, environments and vegetation of southern African biomes; major vegetation types of southern Africa; centra of plant endemism; rare and threatened plant species; red data lists; plant conservation; international conventions; local environmental laws; conservation status of southern African vegetation types.

BOT 261 Plant biochemical evolution 261
Academic organisation: Plant Science
Prerequisite: BOT 161, CMY 117, CMY 127 or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Role of biochemical evolution in the survival of plants as stationary organisms (coordination of heterotrophic metabolism on cellular and whole plant level, nitrogen

fixation, defence mechanisms and interaction with other organisms). Families of economic importance, interrelationship between humans and plants; food, medicine, drugs and poisons, landscape architecture, energy, water and industry.

BOT 356 Plant ecophysiology 356
Academic organisation: Plant Science
Prerequisite: BOT 161 or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 18
Module content:
The emphasis is on the efficiency of the mechanisms whereby C3-, C4- en CAM-plants bind CO2 and how it is impacted upon by environmental factors. The mechanisms and factors which determine the respiratory conversion of carbon skeletons and how production is affected thereby will be discussed. Insight into the ecological distribution and manipulation of plants for increased production is gained by discussing the internal mechanisms whereby carbon allocation, hormone production, growth, flowering and fruitset are influenced by external factors. To understand the functioning of plants in diverse environments, the relevant structural properties of plants and the impact of soil composition and water flow in the soil-plant- air continuum will be discussed. Various important techniques in the field of study will be illustrated in the practicals and may be employed to investigate aspects such as: the effect of herbicides on isolated chloroplasts, water-use efficiency of plants, factors affecting stomata opening, determination of plant stress, photosynthetic rate and nitrogen fixation, compilation of Höfler diagrams and determination of elasticity coefficients.

BOT 357 Crop biotechnology 357
Academic organisation: Plant Science
Prerequisite: BOT 161 or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 18
Module content:
Molecular tools in crop biotechnology; whole crop plant physiology explored by molecular techniques; usefulness of model plants; gene and promoter identification and transfer techniques for crop improvement; investigation of plant transcriptomes using microarrays; molecular analysis of plant reactions to stress; transgenic plant strategies for improved stress resistance in crops.

BOT 358 Plant ecology 358
Academic organisation: Plant Science
Prerequisite: BOT 161 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 18
Module content:
A description of the environment of plants. Theory of plant community concepts, vegetation change over space and time; surveying techniques of vegetation and environmental factors; floristic and structural composition. Data processing techniques; ecological interpretation and description of plant communities. Vegetation and environmental management; vegetation and the grazing animal. An examination of the ecological traits of plant populations; conventional and diagrammatic life tables;

population growth and population regulation; population dynamics. Species interactions and an evaluation of their effects on interacting species.

BOT 365 Phytomedicine 365
Academic organisation: Plant Science
Prerequisite: BOT 161 or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
The module will include a review on the discovery and use of plant medicines and phyto-therapeutically important molecules obtained from plants. Certain aspects of natural product chemistry i.e. the biosynthesis and ecological role of the three main classes of secondary compounds; terpenoids, phenolics, and alkaloids will be discussed. The role of these natural products in defence against microorganisms and herbivores will be presented during the module. The basics of alternative medicines such as homeopathy, ayurvedic medicine, acupuncture etc. will also be discussed. Key skills/practical elements to be covered in the module include modern techniques like high-performance liquid chromatography and flash chromatography used for the detection and isolation of active compounds from medicinal plants. Practical drug discovery approaches using chromato-graphic techniques for phytochemical analysis of secondary metabolites such as tannins, alkaloids, sterols and saponins will be conducted. Bioassays on micro-organisms will also be done during the practical sessions in order to develop the skills for the potential discovery of new antibiotics. Visits to several pharmaceutical laboratories will be arranged.

BOT 366 Plant diversity 366
Academic organisation: Plant Science
Prerequisite: BOT 161 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 18
Module content:
Basic principles and methods of plant classification. Sources of plant variation. Modern methods to ascertain evolutionary relationships among plants. The extent and significance of vascular plant diversity. General structural and biological characteristics of evolutionary and ecologically important plant groups. Botanical nomenclature. Plant identification in practice; identification methods, keys, herbaria and botanical gardens. Diagnostic characters for the field identification of trees, wild flowers and grasses. Family recognition of southern African plants. Available literature for plant identification. Methods to conduct floristic surveys. Nature and significance of voucher specimens.

CGS 152 Introductory physics 152
Academic organisation: Physics
Contact time: 2 lpw 2 ppw 2 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Heat and temp: Thermal interaction; operational definition of temperature; expansion; temperature in the kinetic molecular model; work, energy and heat; phase transitions and mechanisms of heat transfer. Measurements: What is measuring; the scientific

method; measuring error; significant figures. Geometric optics: Light travels straight; shadow formation; plane, convex and concave mirrors; refraction and lenses (thin); optical instruments.
Practicals related to the topics.

CGS 162 Introductory physics 162
Academic organisation: Physics
Prerequisite: CGS 152
Contact time: 2 lpw 2 dpw 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Kinematics: Basic concepts in kinematics in vector notation; different representations to describe motions; instantaneous velocity; acceleration; equations of motion (constant acceleration). Dynamics: Interactions, Newton's third law, Newton's first and second law; gravitation; normal force and friction. Forces in two dimensions: resolving and adding forces. Work energy and power. Electricity: Static and flowing electricity, current, potential difference, power, resistance, simple DC-circuits.
Practicals related to the topics.

CHM 171 General chemistry 171
Academic organisation: Chemistry
Contact time: 4 lpw 1 dpw 1 web-based period per week 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
General introduction to inorganic, analytical and physical chemistry. Nomenclature of inorganic ions and compounds, stoichiometric calculations concerning chemical reactions, redox reactions, solubilities and solutions, atomic structure, periodicity. Molecular structure and chemical bonding using the VSEPR model. Principles of reactivity, electrochemistry, energy and chemical reactions, entropy and free energy. Appropriate tutorial classes and practicals.

CHM 172 General chemistry 172
Academic organisation: Chemistry
Contact time: 1 ppw 1 web-based period per week 1 dpw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
General introduction to inorganic, analytical and physical chemistry. Nomenclature of inorganic ions and compounds, stoichiometric calculations concerning chemical reactions, redox reactions, solubilities and solutions, atomic structure, periodicity. Molecular structure and chemical bonding using the VSEPR model. Principles of reactivity, electrochemistry, energy and chemical reactions, entropy and free energy.
Appropriate tutorial classes and practicals.

CHM 181 General chemistry 181
Academic organisation: Chemistry
Contact time: 4 lpw 1 ppw 1 web-based period per week 1 dpw
Period of presentation: Semester 2

Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
General physical-analytical chemistry: Physical behaviour of gases, liquids and solids, intermolecular forces, solutions, chemical equilibrium, acids and bases, buffers, precipitation. Organic chemistry: Structure (bonding) and functional groups, nomenclature, isomerism, introductory stereo-chemistry, introduction to chemical reactions and chemical properties of organic compounds. Appropriate tutorial classes and practicals.

CHM 215 Chemistry 215
Academic organisation: Chemistry
Prerequisite: CHM 171 or CHM 172 and CHM 181
Contact time: 1 web-based period per week 3 lpw 1 ppw 1 dpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Organic chemistry. Chemical properties of organic (including aromatic) compounds. Functional group transformation and synthesis. Physical chemistry. Colloid chemistry. Surface chemistry and processes at solid surfaces. PVT properties of real gases.

CHM 226 Chemistry 226
Academic organisation: Chemistry
Prerequisite: CHM 171 or CHM 172 and CHM 181
Contact time: 2 lpw 6 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 8
Module content:
Theory: Introduction to instrumental chemical analysis. Integration of electronic, chemical, optical and computer principles for the construction of analytical instrumentation. Detail discussion of principles and some instrumental methods from three disciplines within analytical chemistry, namely electrochemistry, spectroscopy and chromatography. This includes potentiometry, (AA) atomic absorption-, (ICP) atomic emission-, ultraviolet (UV)-, and infrared (IR) spectroscopy, potentiometric and photometric titrations, gas chromatography, liquid chromatography as well as combinations of these techniques. Practical: IR spectroscopy, UV spectroscopy, AA spectroscopy, potentiometric titration, gas chromatography.

CMY 117 General chemistry 117
Academic organisation: Chemistry
Prerequisite: Refer to Regulation 1.2
Contact time: 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Theory: General introduction to inorganic and analytical chemistry. Nomenclature of inorganic ions and compounds, stoichiometric calculations concerning chemical

reactions, redox reactions, solubilities, atomic structure, periodicity. Inorganic and physical chemistry. Molecular structure and chemical bonding using the VSEPR models. Chemical equilibrium, acids and bases, buffers, precipitation.

CMY 127 General chemistry 127
Academic organisation: Chemistry
Prerequisite: Natural and Agricultural Sciences students: CMY 117 GS
Health Sciences students: none
Contact time: 1 ppw 4 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 16
Module content:
Theory: General physical-analytical chemistry: Physical behaviour of gases, liquids and solids, intermolecular forces, solutions: Organic chemistry: Structure (bonding), nomenclature, isomerism, introductory stereochemistry, introduction to chemical reactions and chemical properties of organic compounds and biological compounds, i.e. carbohydrates, lipids and aminoacids. Practical: Molecular structure (model building), synthesis and properties of simple organic compounds.

CMY 133 Chemistry 133
Academic organisation: Chemistry
Prerequisite: As for BSc Four-year programme
Contact time: Foundation Course Fortnightly practicals 3 dpw 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
The field of Chemistry – an overview; Mathematics in Chemistry; atomic theory: historical overview; atoms, molecules and ions; relative atomic mass; electronic structure of atoms; the periodic table; periodicity; chemical bonding.

CMY 143 Chemistry 143
Academic organisation: Chemistry
Prerequisite: CMY 133
Contact time: Foundation Course 2 lpw Fortnightly practicals 3 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Bonding and molecular geometry: VSEPR theory; bonding and organic compounds (structural formulas, classification and nomenclature); matter and its properties; mole concept; reaction stoichiometry; reactions in aqueous solutions: precipitation, acid base and redox.

CMY 151 Chemistry 151
Academic organisation: Chemistry
Prerequisite: Refer to Regulation 1.2
Contact time: 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Theory: Introduction to general chemistry: Measurement in chemistry, matter and energy, atomic theory and the periodic table, chemical compounds and chemical

bonds; quantitative relationships in chemical reactions, states of matter and the kinetic theory; solutions and colloids, acids, bases and ionic compounds, chemical equilibria. Introduction to organic chemistry: Chemical bonding in organic compounds, nature, physical properties and nomenclature of simple organic molecules, isomerism, chemical properties of alkanes and cycloalkanes, alkenes, alcohols, aldehydes and ketones, carboxylic acids and esters, amines and amides, carbohydrates, proteins, and lipids.
Practicals.

CMY 154 Chemistry 154
Academic organisation: Chemistry
Contact time: 3 lpw fortnightly practicals Foundation Course 2 tpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Chemical equilibrium; acid and base equilibria; applications of aqueous equilibria: buffers and solubility; Introduction to electrochemistry; introduction to thermochemistry and thermodynamics; Introduction to electrochemistryorganic chemistry: hybridisation, isomers (structural, geometrical and conformational), reactions (substitution, addition and elimination), introduction to reaction mechanisms.

CMY 282 Physical chemistry 282
Academic organisation: Chemistry
Prerequisite: CMY 117 and CMY 127
Contact time: 2 ppw 4 lpw 1 tpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 12
Module content:
Theory: Classical chemical thermodynamics, gases, first and second law and applications, physical changes of pure materials and simple compounds. Phase rule: Chemical reactions, chemical kinetics, rates of reactions. Fundamentals of spectroscopy (including NMR).

CMY 283 Analytical chemistry 283
Academic organisation: Chemistry
Prerequisite: CMY 117 and CMY 127
Contact time: 4 lpw 2 ppw 1 tpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 12
Module content:
Theory: Statistical evaluation of data, gravimetric analysis, aqueous solution chemistry, chemical equilibrium, precipitation-, neutralisation- and complex formation titrations, redox titrations, potentiometric methods, introduction to electrochemistry.

CMY 284 Organic chemistry 284
Academic organisation: Chemistry
Prerequisite: CMY 117 and CMY 127
Contact time: 1 tpw 4 lpw 2 ppw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 12
Module content:
*Selection criteria based on performance in CMY 127 will be applied due to limited capacity in the practical course.
Theory: NMR spectroscopy: Applications, Organic reactivity: Rates and equilibrium. Acidity and basicity. Conjugation and resonance: Allylic systems. Alkenes, alkyl halides, alcohols, ethers. Carbonyl compounds: ketones, aldehydes, carboxylic acids and their derivatives. Dynamic stereochemistry: Nucleophilic substitution, elimination, addition.

CMY 285 Inorganic chemistry 285
Academic organisation: Chemistry
Prerequisite: CMY 117 and CMY 127
Contact time: 2 ppw 1 tpw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 12
Module content:
Theory: Atomic structure, structure of solids (ionic model). Co-ordination chemistry of transition metals: Oxidation states of transition metals, ligands, stereochemistry, crystal field theory, consequences of d-orbital splitting, chemistry of the main group elements, acid-base concepts, non-aqueous solvents, electrochemical properties of transition metals in aqueous solution, industrial applications of transition metals. Introduction to IR spectroscopy.

CMY 382 Physical chemistry 382
Academic organisation: Chemistry
Prerequisite: CMY 282, CMY 283, CMY 284 and CMY 285
Contact time: 1 dpw 4 lpw 1 ppw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
Theory: Molecular quantum mechanics. Introduction: Shortcomings of classical physics, dynamics of microscopic systems, quantum mechanical principles, translational, vibrational and rotational movement. Atomic structure and spectra: Atomic hydrogen, multiple electron systems, spectra of complex atoms, molecular structure, the hydrogen molecule ion, diatomic and polyatomic molecules, structure and properties of molecules. Molecules in motion: Viscosity, diffusion, mobility. Surface chemistry: Physisorption and chemisorption, adsorption isotherms, surface tension, heterogeneous catalytic rate reactions, capillarity.

CMY 383 Analytical chemistry 383
Academic organisation: Chemistry
Prerequisite: CMY 282, CMY 283, CMY 284 and CMY 285
Contact time: 4 lpw 1 ppw 1 dpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 18
Module content:
Theory: Separation methods: Extraction, multiple extraction, chromatographic systems. Spectroscopy: Construction of instruments, atomic absorption and atomic emission spectrometry, surface analysis techniques. Mass spectrometry. Instrumental electrochemistry.

CMY 384 Organic chemistry 384
Academic organisation: Chemistry
Prerequisite: CMY 282, CMY 283, CMY 284 and CMY 285
Contact time: 1 tpw 4 lpw 1 ppw
Period of presentation: Quarter 3

Language of tuition: English **Credits:** 18
Module content:
Theory: Aromaticity and aromatic chemistry, synthetic methodology in organic chemistry: Carbon-carbon bond formation: Alkylation at nucleophilic carbon sites, aldol and related condensations, Wittig and related reactions, acylation of carbanions (Claisen condensation).

CMY 385 Inorganic chemistry 385
Academic organisation: Chemistry
Prerequisite: CMY 282, CMY 283, CMY 284 and CMY 285
Contact time: 1 dpw 1 ppw 4 lpw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 18
Module content:
Theory: Structure and bonding in inorganic chemistry: Molecular orbital approach, diatomic and polyatomic molecules, three-centre bonds, metal-metal bonds, transition metal complexes, magnetic properties, electronic spectra, reactivity and reaction mechanisms, reaction types, special topics.

DAF 200 Animal anatomy and physiology 200
Academic organisation: Animal and Wildlife Sciences
Prerequisite: CMY 127 or TDH
Contact time: 4 lpw 1 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 36
Module content:
General structure and plan of the body of livestock. Types and characteristics of cells and tissues. Body water. Anatomy, physiology and histology of systems: Skin; skeleton; muscles, connective tissue, ligaments, joints; nervous system; sensory organs of sight, sound, smell, touch, taste; circulatory system; respiratory system; endocrinology; male and female reproductive systems; digestive system, gastrointestinal tract, liver, pancreas; kidneys, acid-base balance and homeostasis; lactation; immune system. General species differences.

DAN 310 Animal anatomy 310
Academic organisation: Animal and Wildlife Sciences
Prerequisite: DAF 200
Contact time: 1 lpw fortnightly practicals
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Functional anatomy, growth and development of tissues and organ systems. Changes during maturation, reproduction, the post-partum period and lactation. Ageing and tissue changes with erosion diseases. The influence of hormones, production and reproduction on conformation and a critical evaluation of assessment of animals for functional efficiency.

DFS 311 Animal physiology 311
Academic organisation: Animal and Wildlife Sciences
Prerequisite: DAF 200
Contact time: 2 lpw
Period of presentation: Semester 1

Language of tuition: Both Afr and Eng **Credits:** 10
Module content:
Homeostasis and Homeorhesis in animals: Thermoregulation. Adaptation of glucose, lipid and protein metabolism in response to short and long-term changes in the supply and balance of nutrients and to changes in tissue demand for nutrients during different physiological states. Deviations from normal homeostasis, metabolic diseases and the prevention thereof. Pathogenesis of inflammation and infections; immunity.

DFS 320 Growth physiology 320
Academic organisation: Animal and Wildlife Sciences
Prerequisite: DFS311 + DAN 310
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 10
Module content:
The underlying physiological processes in growth and development. Pre- and postnatal growth and factors which determine growth rate: growth curves, stimulants of growth, age, nutrition, race, gender, et al.

ERG 282 Ergonomics 282
Academic organisation: Consumer Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 8
Module content:
Study of general ergonomic principles as applied to the design of workplaces, workspaces and ways of performing work. The interaction between the human (user) and his work, workspace (immediate surroundings, including space layout, furniture, movement patterns) and the general environment (climate, lighting, and noise, etc.) serve as a point of reference.

EST 121 Aesthetics 121
Academic organisation: Consumer Science
Prerequisite: OBG 111
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 9
Module content:
Presentation techniques: story boards and technical drawings. Presentation techniques using CAD.

EST 212 Aesthetics: Product, consumer and environment 212
Academic organisation: Consumer Science
Prerequisite: EST 121
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 10
Module content:
Introduction to aesthetics: framework of approach; physical as premise; role of clothing and clothing environments; perceptual process; factors that influence evaluation. Aesthetics of the product: Design elements in clothing products; visual, tactile, audio and olfactory elements; complexity, order, novelty. Aesthetics of the consumer: figure analysis; colour; design elements: clothing product and figure. Aesthetics of the environment: visual presentation in clothing environments.

FPP 451 Chemical and microbiological aspects of food 451
Academic organisation: Food Science
Prerequisite: Third-year status or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: English **Credits:** 20
Module content:
Chemical aspects: The role and composition of the major chemical components of food (water, carbohydrates, proteins and lipids). The content and nutritional role of different minor chemical components of food (minerals and vitamins). The principles and control of enzymic and non-enzymic browning. The composition and use of enzymes in food processing. Microbiological aspects: Introduction to micro-organisms. Intrinsic and extrinsic factors that affect growth and survival of micro-organisms. Important microbial groups in food. Microbial spoilage of foods. Determination of micro-organisms and/or their products in foods. The preservation of foods. Microbial indicators of food safety and quality. Food borne diseases and intoxications. The utilisation of micro-organisms in food production.

FSK 116 Physics 116
Academic organisation: Physics
Prerequisite: WTW 114 # and refer to Regulation 1.2
Contact time: 1 dpw 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introductory mathematics: Symbols, exponents, logarithms, angles in degrees, radial measure, goniometry, differentiation, and integration. Motion along a straight line: position and displacement, acceleration. Vectors: adding vectors, components,

multiplying vectors. Motion in two and three dimensions: projectile motion, circular motion. Force and motion: Newton's Law, force, friction. Kinetic energy and work: work, power. Potential energy: Centre of mass, linear momentum. Collisions: impulse and linear momentum, elastic collisions, inelastic collisions. Rotation: kinetic energy of rotation, torque. Oscillations and waves: Simple harmonic motion, types of waves, wavelength and frequency, interference of waves, standing waves, the Doppler effect. Temperature, heat and the first law of thermodynamics.

FSK 176 Physics 176
Academic organisation: Physics
Contact time: 4 lpw 1 dpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Introductory mathematics: Symbols, exponents, logarithms, angles in degrees, radial measure, goniometry, differentiation, and integration. Motion along a straight line: position and displacement, acceleration. Vectors: adding vectors, components, multiplying vectors. Motion in two and three dimensions: projectile motion, circular motion. Force and motion: Newton's Law, force, friction. Kinetic energy and work: work, power. Potential energy: Centre of mass, linear momentum. Collisions: impulse and linear momentum, elastic collisions, inelastic collisions. Rotation: kinetic energy of rotation, torque. Oscillations and waves: Simple harmonic motion, types of waves, wavelength and frequency, interference of waves, standing waves, the Doppler effect. Temperature, heat and the first law of thermodynamics.

FST 250 Introduction to food science and technology 250
Academic organisation: Food Science
Prerequisite: CMY 117, CMY 127, MBY 161, PHY 131 and WTW 134 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
Lectures: Food Science as a discipline. Activities of Food Scientists and Nutritionists. How food is produced, processed and distributed (food pipeline). World food problem. Human nutrition and human food requirements. Constituents of foods: Functional properties. Food quality. Food deterioration and control (food preservation). Unit operations in food processing. Food safety, risks and hazards. Principles of food packaging. Food legislation and labelling. Food processing and the environment. Practicals: Group assignments applying the theory in practice; practical demonstrations in pilot plants; guest lecturers on the world of food scientists and nutritionists; factory visit/videos of food processing.

FST 260 Principles of food processing and preservation 260
Academic organisation: Food Science
Prerequisite: CMY 117, CMY 127, MBY 161, PHY 131 and WTW 134 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
Lectures: Food preservation technologies: concept of hurdle technology; heat (blanching, pasteurisation and sterilisation); cold (refrigeration and freezing); concentration and dehydration; food irradiation; fermentation; preservatives; new

methods of food preservation. Effect of various food preservation technologies on the microbiological (shelf-life and safety issues), sensory and nutritional quality of foods. Practicals: Practical applications of above processes. Physical, chemical and sensory evaluation of processed foods. Assignment: Application of hurdle technology concept to a specific food product.

FST 350 Integrated food science 350
Academic organisation: Food Science
Prerequisite: Second-year status, FST 250 and FST 260 or TDH
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 18
Module content:
Literature studies and seminar presentations on topics in food science, nutrition and health.

FST 351 Food chemistry 351
Academic organisation: Food Science
Prerequisite: [BCM 255 and BCM 256] and [BCM 263 and BCM 264] and [BCM 265 and BCM 266] or TDH and [BCM 253 and BCM 254]
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Lectures - Chemistry of major food components: Carbohydrates. Proteins. Lipids. Water. Chemical and nutritional aspects of food processing: implications of different processing techniques on the major food components. Functional properties of the major food components. Modification of functional properties of the major food components. Food analysis methodology. Practical work: Food analysis.

FST 352 Food chemistry (2) 352
Academic organisation: Food Science
Prerequisite: [BCM 255 and BCM 256] and [BCM 263 and BCM 264] and [BCM 265 and BCM 266] and [BCM 253 and BCM 254]
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Lectures - Basic food analysis and chemistry of the minor food components: Basic food analysis, vitamins, minerals, additives, contaminants. Chemical and nutritional aspects of food processing: implications of different processing techniques on minor food components. Functional properties of the minor food components. Food analysis methodology. Practical work: Food analysis.

FST 353 Food engineering 353
Academic organisation: Food Science
Prerequisite: FST 260 or TDH
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Lectures: Mass and energy balance. Heat transfer theory: Convection, conduction and

radiation. Energy for food processing. Fluid flow and rheology. Unit operations: materials handling, cleaning, sorting, grading, peeling, disintegration, separation (e.g. membrane technology), pumping, mixing and forming, heating, concentration, drying, extrusion, refrigeration, freezing. Tutorials/practicals: Calculations on mass and energy balances, psychrometry, refrigeration and freezing.

FST 360 Principles of the science and technology of plant foods 360
Academic organisation: Food Science
Prerequisite: FST 250, FST 260, FST 351 and FST 352 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Cereal and legume grains, oilseeds and fruits and vegetables: Composition and structure. Quality assessment and grading. Post-harvest storage and physiology. Cleaning and sorting principles and technologies. Milling – principles and technologies, and their effects on product functionality and nutrient composition. Juice and oil extraction – principles and technologies, and their effects on product functionality and nutrient composition. Bread and baked goods making – principles and technologies, and their effects on product functionality and nutrient composition. Practical work: Laboratory analyses of components and products of cereals, oilseeds, legumes and fruits and vegetables; Determination of quality; Factory visits.

FST 361 Animal food science 361
Academic organisation: Food Science
Prerequisite: FST 250, FST 260, FST 351 and FST 352 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Dairy science: Composition of milk; some physical properties of milk; factors affecting composition of milk; microbiological aspects of milk production; lactation; mechanical milking; milk defects; nutritive value of milk and milk products. Practical work: Chemical and microbiological tests of milk. Demonstration of the cheese-making process. Meat, poultry, fish and egg science: The composition, nutritional value and quality of meat, poultry, fish and eggs; factors affecting quality from slaughter or harvesting to consumption. Practical work: Visits to red meat and poultry abattoirs; quality determinations, egg quality and protein functionality.

FST 400 Research methodology and seminar 400
Academic organisation: Food Science
Prerequisite: Third-year status or TDH
Contact time: 1 workshop of 5 days in semester 1 1 day seminar in semester 2
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Lectures and assignments: Research methodology. Literature study and seminar presentations on topics in food science and/or technology. The student must also pass an oral examination at the end of the module.

FST 401 Animal food technology 401
Academic organisation: Food Science
Prerequisite: FST 361 or TDH
Contact time: 9 practical sessions 30 discussion classes
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Dairy technology: The technology of fluid, concentrated, dried, frozen and fermented dairy products and starter cultures. Requirements for milk supply and other ingredients. Principles for the manufacturing of products in this category. Possible defects, causes and prevention. Practical work: Preparation of condensed milk, custard, ready-to-eat milk-based desserts, flavoured milk beverages, dairy-fruit juice mixtures; ice cream and other frozen desserts; yoghurt and cultured milk products; cheeses. Evaluation and analysis of the products. Effect of processing on nutritional value of dairy products. Factory visits. Meat, poultry, fish and egg technology: Meat, poultry, fish and egg processing and equipment. Meat emulsion, curing, dehydration and fermentation technology. Preservation and storage. Packaging. Legislation. Quality control and hygiene. Effect of processing on nutritional value of meat products. Practical work: Manufacturing of dried, cured, fermented and emulsion type products. Visits to processing factories.

FST 402 Advanced plant food science and technology 402
Academic organisation: Food Science
Prerequisite: FST 360 or TDH
Contact time: 5 discussion classes in semester 2 5 practical sessions in semester 1 8 discussion classes in semester 1 3 practical sessions in semester 2
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Plant food functionality: Starch, non-starch polysaccharides, protein. Advanced rheology and texture. Malting and brewing. Ready-to-eat (RTE) technologies and their impact on functional and nutritional quality. Plant oil processing. Minimal processing of fruits and vegetables. Practical work: Pasting properties of starch; Dough rheology; Isolation of legume and cereal proteins; SDS-PAGE electrophoreses of legume and cereal proteins; Malting and mashing of sorghum and barley malt; Extraction of essential oils; Extraction and identification of phenolic compounds; Minimal processing of fruits and vegetables.

FST 412 Sensory evaluation 412
Academic organisation: Food Science
Prerequisite: FST 260, FST 351 and FST 352 or TDH
Contact time: 12 discussion classes 6 practical sessions
Period of presentation: Semester 1
Language of tuition: English **Credits:** 10
Module content:
Principles and applications of sensory evaluation. Types of panels, tests and test conditions and their functions. Selection and training of panellists for descriptive sensory evaluation. Instrumental sensory quality measurements. Statistical analysis and interpretation of data. Practicals: Practical aspects and execution of sensory evaluation techniques, analysis and interpretation of data. Instrumental sensory quality measurements.

FST 413 Product development and quality management 413
Academic organisation: Food Science
Prerequisite: FST 260 or TDH and FST 351 and FST 352
Contact time: 6 practical sessions 15 discussion classes
Period of presentation: Semester 1
Language of tuition: English **Credits:** 30
Module content:
Lectures: Principles involved and steps that are followed to develop new food products that are safe, tasty, nutritious and cost effective. Application of the theory of food product development. Quality management systems with specific reference to Good Manufacturing Practices, HACCP and ISO 9000. National and international standards, Codex Alimentarius, FDA. Application of food legislation. Food Packaging. Practicals: A product development project will be planned, conducted and presented. Application and implementation of HACCP.

FST 414 Research methodology 414
Academic organisation: Food Science
Prerequisite: Third-year status or TDH
Period of presentation: Semester 1

Language of tuition: English **Credits:** 8
Module content:
Five-day intensive research methodology workshop: Philosophy of research; Where to start research - Problem statement; Role and importance of the literature review; How to formulate hypotheses and objectives; Experimental design; The good practical way to do research, including getting the results down; Application of statistics to research; Writing an honours report/masters dissertation/doctoral thesis; Writing a scientific paper; Preparing and presenting posters and oral papers.

FST 420 Advanced food science 420
Academic organisation: Food Science
Prerequisite: Third-year status or TDH
Contact time: 12 discussion classes
Period of presentation: Year
Language of tuition: English **Credits:** 20
Module content:
Discusion classes in advanced level food chemistry, food microbiology, food engineering, food processing and nutrition. Problem solving and literature discussion.

FST 463 Research project 463
Academic organisation: Food Science
Prerequisite: Third-year status in Food Science or TDH
Contact time: 1 ppw
Period of presentation: Year
Language of tuition: English **Credits:** 40
Module content:
Planning, execution and reporting of a research project on a selected Food Science and/or Technology subject.

GGR 361 Environmental resource management 361
Academic organisation: Geography, Geoinformatics and Meteorology
Period of presentation: Semester 2
Language of tuition: English **Credits:** 30
Module content:
Environmental problems and consequences; natural hazards; global responses to environmental problems; waste disposal and management; land degradation; land reform debate in Southern Africa; biodiversity; people and parks debate (a focus on various natural resources management approaches); overpopulation and environmental destruction; sustainable development. Environmental resource conservation in South Africa. Environmental resource management: integrated environmental management; principles and procedures for environmental and social impact assessment; environmental auditing. Environmental resource management techniques and tools: environmental risk assessment; community participation; environmental management programme report; ISO14000; life cycle assessment. The future of environmental management in South Africa.

GGY 156 Introduction to human geography 156
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw
Period of presentation: Quarter 2

Language of tuition: English **Credits:** 6
Module content:
Foundations for understanding contemporary human geographic processes. The module will trace the major changes in the economic, political and population geography of southern Africa and beyond.

GGY 157 Introduction to environmental sciences 157
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 6
Module content:
Introducing the basic concepts and interrelationships required to understand the complexity of natural environmental problems, physical and human environment, human induced environmental problems, the ways in which the natural environment affects human society and biodiversity, an introduction to major environmental issues in Southern Africa and sustainable development in the context of environmental issues.

GGY 158 Geographical skills 158
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 4
Module content:
*Does not require mathematical background. (Module for: BA (with Geography), BSc Environmental Sciences, BSc Earth Science, BSc Geography, BSc Meteorology, B Town and Regional Planning).
Analysis and interpretation of topographical maps, aerial photographs and satellite imagery. Processes and usefulness of remote sensing and GIS, and basic statistical methods.

GGY 166 Southern African geomorphology 166
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 8
Module content:
Investigating southern African landscapes and placing them in a theoretical and global context. The geomorphological evolution of southern Africa. Introduction to the concepts of Geomorphology and its relationships with other physical sciences (e.g. meteorology, climatology, geology, hydrology and biology). The processes and controls of landform and landscape evolution. Tutorial exercises cover basic techniques of geomorphological analysis, and topical issues in Geomorphology.

GGY 252 Process geomorphology 252
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 2

Language of tuition: English **Credits:** 12
Module content:
Physical processes that influence the earth's surface and management. Specific processes and their interaction in themes such as weathering; soil erosion; slope, mass movement and fluvial processes.

GGY 265 Geomorphology of the built environment 265
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw
Period of presentation: Quarter 3
Language of tuition: Double Medium **Credits:** 12
Module content:
*This module is for Architecture and Landscape Architecture students only.
The theory component covers geomorphological aspects of the built environment including landscape identification; weathering or deterioration of natural stone and application to design and preservation of buildings and monuments; slope hydrology and stability conditions; soil erosion processes and construction impacts; drainage modification in urban areas; wetland identification, human impacts and rehabilitation; recreational impacts and management. In addition to the theory a field-based project is undertaken.

GGY 266 City structure, environment and society 266
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
An urbanising world. Urban structure and land use. Urban processes. The urban environment. Social structure and change in cities. Living in the city. Economy, society and politics in the city. Third-world cities and South African cities. Urban futures.

GGY 283 Introductory geographic information systems 283
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
*This is a closed module, only available to students studying [BT&RP] (12132022), [BSc(Arch)] (12132002), [BSc(LArch)] (12132004), BSc Meteorology (02133312), BSc Geoinformatics (02133383), BSc Environmental Science (02133361), BSc Earth Sciences (02133012), BSc Geography (02133385) or as approved by the head of department. The content of this module is the same as GIS 221 and students are not allowed to earn credits for both GGY 283 and GIS 221.
Introduction to Geographic Information Systems (GIS), theoretical concepts and applications of GIS. The focus will be on the GIS process of data input, data analysis, data output and associated technologies.

GGY 355 Human environmental interactions 355
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 18
Module content:
The module focuses on contemporary environmental issues in southern Africa. Recent and future impacts of human pressures on natural resources, the state of the environment in South Africa, management of critical resources, population trends, biodiversity loss, pollution, water scarcity, desertification, climate change, waste accumulation and management, environmental management tools, environmental education and environmental management legislation.

GGY 356 Sustainable development 356
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw 1 ppw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 18
Module content:
The module conceptually integrates environmental, economic, and social components of sustainable development. Other topics covered include changing perceptions on development and environment, development paradigms, challenges of sustainable development, actors and actions in sustainable development, rural and urban livelihoods, and a Third World assessment of sustainable development in the developing world.

GGY 361 Environmental geomorphology 361
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
*Note: The content of this module is the same as GGY 363 and students are not allowed to earn credits for both GGY 361 and GGY 363.
Interactions of geomorphic processes within the physical and built environments; themes such as geomorphology and environmental change, slope processes and the

environment, geomorphic risks and hazards, soil erosion and conservation, geomorphology in environmental management, weathering in urban environments, preservation of buildings, and deterioration and preservation of indigenous rock art. Practicals involve fieldwork and subsequent laboratory analysis, as well as modelling utilising modern computational techniques.

GGY 363 Applied geomorphology 363
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 12
Module content:
*Note: The content of this module is the same as GGY 361 and students are not allowed to earn credits for both GGY 361 and GGY 363.
Interactions of geomorphic processes within the physical and built environments. Geomorphology in environmental management, weathering in urban environments, conservation and preservation of buildings.

GGY 366 Development frameworks 366
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw 3 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 18
Module content:
Classic development frameworks. Spatial development history and legacy in South Africa. Overview of contemporary environmental legislation in South Africa. Rural development strategy. Rural and agricultural reconstruction. Land reform. Urban development and strategy. Urban spatial reconstruction. National spatial development frameworks.

GIS 120 Geoinformatics 120
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GMC110
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
The importance of geographical data and an overview of geoinformatics. Cartographic analysis to geoinformatics – a historical perspective. Application fields of geoinformatics. Introduction to geographical information systems (GIS): Components, structure and functionality, GIS visualisation and cartography. Data sources and evaluation: fitness for purpose, factors affecting suitability, quality and uncertainty, sources of analogue and digital data. Map projection choice. Analysis of GIS output.

GIS 220 Geographic data analysis 220
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
The nature of geographical data and measurement. Probability, probability distributions and densities, expected values and variances, Central Limit theorem.

Sampling techniques. Exploratory data analysis, descriptive statistics, statistical estimation, hypothesis testing, correlation analysis and regression analysis.

GIS 221 Geographic information systems introduction 221
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
*The content of this module is the same as GGY 283 and students are not allowed to earn credits for both GGY 283 and GIS 221.
Introduction to Geographic Information Systems (GIS), theoretical concepts and applications of GIS. The focus will be on the GIS process of data input, data analysis, data output and associated technologies.

GIS 310 Geographic information systems 310
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GGY 283 or GIS 221
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 24
Module content:
Advanced theory and practice of Geographic Information Systems; GIS applications; design and implementation of GIS applications.

GIS 320 Spatial analysis 320
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GIS 310 or TDH
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 24
Module content:
Construction of Raster Geovisualisations, spatial model construction and use, multi-criteria decision analysis. Factor analysis: Principle component analysis. Geostatistics: Spatial dependence modelling, ordinary kriging. Markov chains and cellular Automata, combined models.

GKD 225 General soil science 225
Academic organisation: Plant Production and Soil Science
Contact time: 1 ppw 3 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 12
Module content:
Origin and development of soil, weathering and soil formation processes. Profile differentiation and morphology. Physical characteristics: texture, structure and soil water. Chemical characteristics: Clay minerals, ion exchange, pH and soil fertility. Soil classification. Practical work: Laboratory evaluation of simple soil characteristics. Field practical work on soil formation in the Pretoria area.

GKD 250 Introductory soil science 250
Academic organisation: Plant Production and Soil Science
Prerequisite: CMY 117 GS or TDH
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Origin and development of soil, weathering and soil formation processes. Profile differentiation and morphology. Physical characteristics: texture, structure, soil water, atmosphere and temperature. Chemical characteristics: clay minerals, ion exchange, pH, buffer action, soil acidification and salinisation of soil. Soil fertility and fertilisation. Soil classification. Practical work: Laboratory evaluation of simple soil characteristics. Field practicals on soil formation in the Pretoria area.

GKD 320 Soil chemistry 320
Academic organisation: Plant Production and Soil Science
Prerequisite: GKD 250
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
The more exact chemistry of soils systematically explained by understanding the particular chemical principles. Charge origin. Chemical equilibriums. Manifestations of sorption. Ion exchange. Acidic soils, saline soils and the organic fraction of soil. The chemistry of the important plant nutrient elements P, K and N is explained.

GKD 350 Soil classification and surveying 350
Academic organisation: Plant Production and Soil Science
Prerequisite: GKD 250 GS
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
A taxonomic system for South Africa. USDA's Soil Taxonomy. Land suitability evaluation. Optimal resource utilization. The conservation component. Ecological aspects. Ecotype, land types. Soil maps. Practical work: Field practicals and compulsory excursion. Identification of soil horizons, forms and families. Land suitability evaluation. Elementary mapping exercise.

GKD 351 Soil physics 351
Academic organisation: Plant Production and Soil Science
Prerequisite: GKD 250
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 10
Module content:
A study of some physical properties of soil: structure, texture, compacting and crusting. Sedimentation and sieve analyses for the determination of particle sizes. Conduction of heat. Practical work: Determination of some physical properties of soil.

GKD 420 Soil fertility, soil microbiology and plant nutrition 420
Academic organisation: Plant Production and Soil Science
Prerequisite: GKD 250 GS
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
Soil ultimately controls nutrient supply to plants and organisms. The health and resilience of biota are therefore closely link to the interaction between the pedosphere and the biosphere. This course deals with the availability and uptake of macro and micro nutrients in the plant - microbial– soil system, nutrient deficiencies and toxicities, as well as soil properties and soil environmental conditions that influence soil fertility and its suitability to act as a growth medium. Practical work includes the laboratory evaluation of soil fertility and greenhouse pot trials to investigate nutrient uptake as well as deficiencies and toxicities symptoms in plants.

GLY 151 Introductory geology 151
Academic organisation: Geology
Prerequisite: Refer to Regulation 1.2
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 8
Module content:
Solar system; structure of solid matter; minerals and rocks; introduction to symmetry and crystallography; important minerals and solid solutions; rock cycle; classification of rocks. Crystal models, mineral and rock samples.

GLY 152 Physical geology 152
Academic organisation: Geology
Prerequisite: GLY 151 GS
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 8
Module content:
External geological processes (gravity, water, wind, sea, ice) and their products (including geomorphology). Internal structure of the earth. The dynamic earth – volcanism, earthquakes, mountain building – the theory of plate tectonics. Geological processes (magmatism, metamorphism, sedimentology, structural geology) in a plate tectonic context. Geological maps and rock specimens.

GLY 161 Historical geology 161
Academic organisation: Geology
Prerequisite: GLY 151 GS and GLY 152 GS
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 8
Module content:
Principles of stratigraphy and stratigraphic nomenclature; geological dating and international and South African time scales; Africa framework and tectonic elements of South Africa; introduction to depositional environments. Overview of the historical geology of South Africa, from the Archaean to the present: major stratigraphic units, intrusions and tectonicmetamorphic events - their rock types, fossil contents, genesis

and economic commodities. Principles of palaeontology and short description of major fossil groups: fossil forms, ecology and geological meaning. Geological maps and profiles; rock samples.

GLY 162 Environmental geology 162
Academic organisation: Geology
Prerequisite: Refer to Regulation 1.2
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 8
Module content:
Geological processes and their influence on man's environment: earthquakes, volcanoes, slope movement, subsidence, floods, coastal processes, meteorite impacts, atmospheric changes. Natural resource utilization and the impact of man on the geological environment: urban development, dams, mining, agriculture, transport systems, heavy structures, construction materials, groundwater extraction, waste disposal, environmental pollution. Geological maps, profiles and rock specimens, fossil specimens.

GLY 253 Sedimentology 253
Academic organisation: Geology
Prerequisite: CMY117 and [3 of GLY151, GLY152, GLY161, GLY162] and WTW114/WTW158 or PHY131/PHY171
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 12
Module content:
Introduction to sedimentology; grain studies; composition and textures of sedimentary rocks; flow dynamics and behaviour of sediment particles in transport systems; description and genesis of sedimentary structures; diagenesis; depositional environments and their deposits, modern and ancient; chemical sedimentary rocks; economic sedimentology; field data acquisition from sedimentary rocks and writing of reports; sieve analysis; Markov analysis; analysis of palaeocurrent trends; interpretation of sedimentary profiles.

GLY 254 Structural geology 254
Academic organisation: Geology
Prerequisite: CMY117 and [3 of GLY151, GLY152, GLY161, GLY162] and WTW114 [or WTW158 for Environmental and Engineering Geology] or PHY131/PHY171
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 12
Module content:
Integrated theoretical and practical course dealing with the principles of rock deformation and analysis of deformed rocks. Stress, strain and rheology, joints, experimental rock deformation, fault systems and Anderson's theory of faulting. Folds and interference folding, tectonic fabrics, shear zones, progressive deformation. Stereographic projection and structural analysis.

GLY 255 Fundamental and applied mineralogy 255
Academic organisation: Geology
Prerequisite: Three of GLY 151, GLY 152, GLY 161, GLY 162 and WTW 114/WTW 158 or PHY 131/PHY171
Contact time: 2 ppw 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 24
Module content:
Fundamental concepts in mineralogy, and practical applications of mineralogy, including: the basics of crystal structure; the crystallographic groups; the rules of atomic substitution; phase transitions and phase diagrams; the structure and uses of olivine, pyroxene, feldspar, amphibole, mica, aluminosilicates, garnet, cordierite, and more uncommon mineral groups such as oxides, sulphides and carbonates; the calculation of mineral formulae from chemical analyses using various methods. Practical sessions: the basics of optical mineralogy and the use of transmitted light microscopy for thin section examination of minerals and rocks; the practicals will develop mineral identification skills for the minerals covered in the lectures, and cover basic textural identification.

GLY 261 Igneous petrology 261
Academic organisation: Geology
Prerequisite: GLY 252 or TDH
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 12
Module content:
Classification and nomenclature of igneous rocks. The nature of silicate melts; physical and chemical factors influencing crystallisation and textures of igneous rocks. Phase diagrams, fractional crystallisation and partial melting. Trace elements and isotopes, and their use in petrogenetic studies. Global distribution of magmatism and its origin. Mid-oceanic ridges, active continental margins, intraplate magmatism.

GLY 262 Metamorphic petrology 262
Academic organisation: Geology
Prerequisite: GLY 252 or TDH
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 12
Module content:
Classification of metamorphic rocks. Anatexis, migmatite and granite; eclogite. Metamorphic textures. PT-time loops. Metamorphism in various plate tectonic environments.

GLY 264 Introduction to geophysics 264
Academic organisation: Geology
Prerequisite: Three of GLY 151, GLY 152, GLY 161, GLY 162 and WTW 114/WTW 158 or PHY 131/PHY171
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 12
Module content:
Physical properties of rocks and minerals relevant to exploration geophysics: porosity

and permeability; density; magnetic properties; natural radioactivity; elastic properties; seismic wave attenuation; thermal properties; electrical properties. Basic principles and applications of various geophysical techniques: gravity, magnetic, resistivity, electromagnetic, seismic and radiometric techniques. Mapping techniques.

GLY 265 Groundwater 265
Academic organisation: Geology
Prerequisite: Three of GLY 151, GLY 152, GLY 161, GLY 162] and WTW 114 [or WTW 158 for Environmental and Engineering Geology] or PHY 131
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 12
Module content:
Origin and classification of groundwater; classification of aquifers; groundwater movement; equations for groundwater flow into boreholes; the La Place equation and solutions for pump tests; execution and interpretation of pump tests. Groundwater flow modelling; classification of aquifers in southern Africa; groundwater exploration and management. Mapping techniques.

GLY 352 Geodynamics and ore formation 352
Academic organisation: Geology
Prerequisite: Six of the second year modules: GLY253, GLY254, GLY255, GLY261, GLY262, GLY264, GLY265
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
Principles of ore-forming processes and geological environments of ore formation; ore classification schemes: tectonic, temporal and structural controls on ore formation. Structural interpretation of ore deposits, and mapping techniques.
Compulsory attendance of 3rd year mapping camp and a mark of at least 50% for the accompanying report.

GLY 361 Ore deposits 361
Academic organisation: Geology
Prerequisite: Six of the second year modules: GLY253, GLY254, GLY255, GLY261, GLY262, GLY264, GLY265
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 18
Module content:
Systematic review of major metallic and non-metallic ore types and examples in South Africa and world-wide; ore type models (grades, tonnages); geometry of ore bodies; mining. Ore samples and ore mineralogy. Mapping techniques.

GLY 362 Geostatistics and ore reserve calculations 362
Academic organisation: Geology
Prerequisite: Six of the second year modules: GLY253, GLY254, GLY255, GLY261, GLY262, GLY264, GLY265
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 18

Module content:
Review of classical geostatistical methods; problem evaluation; descriptive statistics, normal-, lognormal, three parameter lognormal distributions; confidence intervals; t-test. Sampling; cut-off values; grid generation and trend surface analysis. Semivariogram; error estimation; Kriging (BLUE) techniques. Ore reserve calculations.

GLY 363 Engineering geology 363
Academic organisation: Geology
Prerequisite: GLY152 and GLY265 and 5 of the second year modules: GLY253, GLY254, GLY255, GLY261, GLY262, GLY264
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 18
Module content:
Definition and scope of engineering geology; engineering geological properties and problems of rocks and soils within different stratigraphic units and climatic regions in southern Africa.

GLY 364 Rock mechanics 364
Academic organisation: Geology
Prerequisite: 6 of the second-year courses: GLY255, GLY253, GLY254, GLY261, GLY262, GLY264, GLY265
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
Strength and failure modes of rock material and rock failure criteria. The characteristics of joints in rock. Joint line surveys and interpretation of data. Characteristics of a rock mass, rock mass classification and determination of strength. Slope stability in surface mines. Induced seismicity due to deep mining and rock bursts.

GMA 220 Remote sensing 220
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
This module will provide a thorough introduction to the basic scientific principles involved in remote sensing, and some of the applications to studies of the Earth's surface. This include examining the basic physics of electromagnetic radiation and the complex interactions of radiation with the surface and atmosphere (i.e. spectral signatures). In addition, basic concepts of photogrammetry will be discussed. The theoretical background laid out in the first half of the module will provide the tools for examining various remote sensing applications using data obtained in different parts of the electromagnetic spectrum. The applications will include uses of satellite remote sensing data for mapping and monitoring vegetation, soils and minerals, snow and ice, water resources and quality, and urban landscapes. The laboratory section will include hands-on experience with various satellite image data sets.

GMA 320 Remote sensing 320
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GMA 220 or TDH
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 24
Module content:
This module aims to provide students with a working knowledge and skills to learn methods and techniques for collecting, processing and analysing remotely sensed data. Throughout the module, emphasis will be placed on image processing, image analysis, image classification, remote sensing and applications of remote sensing in geographical analysis and environmental monitoring. The module is composed of lectures, readings, laboratory exercises and research tasks.

GMC 110 Cartography 110
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1

Language of tuition: Double Medium **Credits:** 12
Module content:
History, present and future of cartography. Introductory geodesy: shape of the earth, graticule and grids, datum definition, elementary map projection theory, spherical calculations. Representation of geographical data on maps: Cartographic design, cartographic abstraction, levels of measurement and visual variables. Semiotics for cartography: signs, sign systems, map semantics and syntactics, explicit and implicit meaning of maps (map pragmatics).

GMC 310 Geometrical and space geodesy 310
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GMC110 and WTW114
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 24
Module content:
Spherical trigonometry. Geometrical Geodesy: Datum surfaces and coordinate systems in Geodesy, Calculations on the ellipsoid, Datum transformations. Map projections: Projection principles, distortion determination, construction of conformal, equivalent and equidistant projections, the Transverse Mercator projection and UTM projection of an ellipsoidal earth, projection transformations. Space Geodesy: Time systems, Celestial and observer coordinate systems, Global Navigation Satellite Systems (GNSS), Satellite orbits and orbital parameters, 3¬ D positioning.

GMT 320 Geoinformatics project 320
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: GIS310 and INF214 and INF261 or TDH. Only for Geoinformatics students.
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 24
Module content:
A project which is approved by the lecturer and in which one or more of the studied

techniques of data acquisition and processing are used to produce an output of spatially referenced information. The project must be fully described in a project report.

GTS 161 Introductory genetics 161
Academic organisation: Genetics
Prerequisite: MLB 111 GS or TDH
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Principles of Mendelian inheritance: Concepts such as locus and allele, dominance interactions and epistasis. Introductory cytogenetics, the karyotype and cell division. Probability studies. Genetic linkage and chromosome mapping. Sex determination and sex linked traits. Inheritance of cytoplasmic DNA and cytoplasmic effects.

GTS 251 Gene and chromosome organisation 251
Academic organisation: Genetics
Prerequisite: GTS 161 GS or TDH
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
Introduction to molecular genetics: Gene structure, transcription and translation, gene regulation, DNA replication, mutation, DNA repair and transposition. Extranuclear inheritance. The genetic basis of cancer and immunity.

GTS 261 Genetic analysis and manipulation 261
Academic organisation: Genetics
Prerequisite: GTS 161 GS or TDH
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
Creation of variation in micro-organisms: transformation, conjugation and transduction. Basic concepts of recombinant DNA technology and its applications in gene analysis and manipulation. Introduction to genetic analysis of populations: allele and genotypic frequencies, breeding systems and quantitative inheritance.

GTS 351 Eukaryotic gene control and development 351
Academic organisation: Genetics
Prerequisite: GTS 251 GS and GTS 261 GS or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Regulation of gene expression in eukaryotes: regulation at the genome, transcription, RNA processing and translation levels. Applications of the principles of gene control: cancer, development and differentiation of plants and animals. Aspects of the epigenetic control of gene expression.

GTS 352 Genomes 352
Academic organisation: Genetics
Prerequisite: GTS 251 GS and GTS 261 GS or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Analysis of the genome as central entity in molecular genetics. Comparison of the molecular organization of prokaryote and eukaryote genomes, nuclear and mitochondrial genomes. Genome organization in different organisms; gene families, overlapping genes, pseudogenes, DNA repeat content. Genetic techniques for genome mapping, physical mapping, genome sequencing and the localization of genes. Processing of DNA sequencing data using computer technology. Approaches for studying genome function. Functional genomics, transcriptomics and proteomics. Genome evolution.

GTS 353 Advanced population genetics 353
Academic organisation: Genetics
Prerequisite: GTS 251 GS and GTS 261 GS or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Genetic variation and mating systems. Allele frequency change: genetic drift, natural and kin selection, mutation and migration. Molecular evolution: nucleotide substitutions to multigene families, and the neutral theory. Quantitative genetics: analysis of genetic variation, heritability, natural selection and artificial selection of quantitative traits. Identification of quantitative trait loci (QTLs).

GTS 361 Human genetics 361
Academic organisation: Genetics
Prerequisite: GTS 352 GS or TDH
Contact time: 2 ppw 4 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Human karyotype. Pedigree analysis and the inheritance of single gene traits in humans, concepts such as X-chromosome inactivation, variable expressivity, penetrance, locus heterogeneity, genomic imprinting and mosaicism. Developmental genetics. Genetic differentiation of sex and sex chromosome abnormalities. Cytogenetic and molecular basis of genetic diseases. Linkage analysis and the identification of human disease genes. Genetics of the immune system.

GTS 363 Evolutionary and phylo-genetics 363
Academic organisation: Genetics
Prerequisite: GTS 353 GS or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Origin of life's code. Molecular evolution and analytical tools. Determining the molecular ecology and evolutionary history of populations and species, and its

applications in conservation, medical sciences and human evolution. Optimality, phylogenetic and molecular studies of adaptation; Evolution of sexual reproduction, resistance and virulence, and its practical applications; Evolutionary arms races.

GTS 365 Applied medical genetics 365
Academic organisation: Genetics
Prerequisite: GTS 251 GS and GTS 261 GS or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
The clinical manifestations of common Mendelian diseases and congenital anomalies; Risk assessment/calculation and genetic counselling; genes and diseases - the use of polymorphisms, gene mapping, gene linkage and association studies in medicine; genetic diagnosis - common molecular and cytogenetic techniques and the applications thereof; carrier detection and predictive testing; population screening - prenatal and neonatal screening; Treatment of genetic diseases and gene based therapy; pharmacogenetics and cancer genetics. Ethical issues.

GTS 366 Plant genetics and biotechnology 366
Academic organisation: Genetics
Prerequisite: GTS 251 GS and GTS 261 GS or TDH and GTS 351 and GTS 352 are recommended
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Plant genetic resources and genetic systems. Plant genome organisation and evolution. Control of gene expression in plants: cis and trans regulation, mRNA stability, gene silencing and RNA signaling, regulation of cytoplasmic genes, light/dark regulation, hormonal control and signal transduction during defense. Protein processing. Developmental genetics: seed/embryo development, control of vascular development and flowering. Genetics of male sterility and selfincompatibility. Plant biotechnology, tissue and cell cultures, plant transformation and regeneration.

GVK 420 Large stock science 420
Academic organisation: Animal and Wildlife Sciences
Prerequisite: RPL 320, VGE 301 and VKU 210
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 12
Module content:
Industrial science and management of large stock. Revision of the principles of agricultural management. Aspects of business management of the large stock enterprise. Management programmes, production systems and techniques applicable to beef cattle, dairy cattle and horses. Design and planning of farm buildings and structures. Storage and handling of fodder. The handling and management of refuse. Hygiene and herd health programmes.

HSC 260 Crop propagation 260
Academic organisation: Plant Production and Soil Science
Prerequisite: BOT 161
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Propagation by seed: seed development, including pollination, fertilisation, embryogenesis fruit and seed development; principles and techniques of seed production; seed physiology; principles and practical aspects of seed germination; seed testing and legislation. Vegetative propagation: principles and techniques of rooting of cuttings; budding and grafting; propagation using specialized organs; micro propagation (tissue culturing). Students will get hands-on experience and will visit companies and nurseries.

HSC 320 Fruit production 320
Academic organisation: Plant Production and Soil Science
Prerequisite: GKD 250 and PGW 350
Period of presentation: Semester 2

Language of tuition: Both Afr and Eng **Credits:** 26
Module content:
Crop modelling, climate zones, climate requirements, cultivation regions, economic importance, anatomy and morphology, phenological modelling. Commercially important scions, rootstocks and their interactions. Crop management including fertilization, irrigation, pest and disease complex, tree and fruit manipulation, physiological disorders of economically important tropical, subtropical and temperate fruit crops produced in Southern Africa.

HSC 351 Nursery management 351
Academic organisation: Plant Production and Soil Science
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
The nursery industry in South Africa. Greenhouse environmental control. Requirements for soil-based and soil-less growing media. The production of plants in a nursery. Management, economical and marketing aspects of different nursery operations. Practical experience on the experimental farm or in nurseries of own choice is compulsory for all participants in this module.

HSC 490 Ornamental horticulture 490
Academic organisation: Plant Production and Soil Science
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
Economic importance of cut flowers and pot plants. Taxonomy and plant description. Climatic requirements and production practices including establishing, growth manipulation, nutritional requirements, irrigation, pest and disease control, harvest and post-harvest handling. Identification of ornamental plants for commercial and landscape use. Climatic, reproduction and maintenance requirements for trees, palms,

shrubs, flowering plants, ground covers, climbers and indoor plants. Functional and aesthetic value of plants in a landscape or indoors. Excursions to nurseries and practical experience on the experimental farm is compulsory for all participants in this module.

IAS 211 Actuarial mathematics 211
Academic organisation: Insurance and Actuarial Science
Prerequisite: Both WTW 114 and WTW 128 60%
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Accumulation functions, interest, time value of money, compounding periods, cashflow models, equations of value, annuities certain, continuous time application, life tables, derivation of contingent probabilities from life tables, contingent payments, fundamentals of survival models, simple laws of mortality, expectation of life, elementary survival contracts, commutation functions, premiums for elementary survival contracts.

IAS 221 Actuarial mathematics 221
Academic organisation: Insurance and Actuarial Science
Prerequisite: IAS 211 GS #
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Select and ultimate life tables, advanced life annuities, accumulation and discounting, life insurance, net and gross premiums, reserves, pension applications, statistical considerations, loan schedules, performance measurement, valuation of fixed interest securities.

IAS 282 Financial mathematics 282
Academic organisation: Insurance and Actuarial Science
Prerequisite: IAS 211 70%
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
Generalised cash-flow model. The time value of money. Interest rates. Discounting and accumulating. Compound interest functions. Equations of value. Loan schedules. Project appraisal. Investments. Simple compound interest problems. The ''No Arbitrage'' assumption and forward contracts. Term structure of interest rates. Stochastic interest rate models.

IAS 361 Insurance and actuarial applications 361
Academic organisation: Insurance and Actuarial Science
Prerequisite: IAS 211 GS
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Concepts of risk and insurance, legal aspects, common products, product providers, pricing, reserving, reinsurance, accounting, wider fields, professionalism.

IAS 382 Actuarial modelling 382
Academic organisation: Insurance and Actuarial Science
Prerequisite: IAS 282
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 20
Module content:
Principles of actuarial modelling and stochastic processes. Markov chains and continuous-time Markov jump processes. Simulation of stochastic processes. Survival models and the life table. Estimating the lifetime distribution Fx(t). The Cox regression model. The two-state Markov model. The general Markov model. Binomial and Poisson models. Graduation and statistical tests. Methods of graduation. Exposed to risk. The evaluation of assurances and annuities. Premiums and reserves.

INB 220 Interior planning 220
Academic organisation: Consumer Science
Prerequisite: ERG 282 GS and OBG 111
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 16
Module content:
Advanced colour theory; basic interior planning; visual presentations for clients; including storyboards and computer-aided design. Evaluation of floor plans; arrangement of furniture.

INB 320 Interior planning 320
Academic organisation: Consumer Science
Prerequisite: ITW 311 and OBG 111
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 11
Module content:
The planning and arrangement of existing living and working spaces to provide for the various needs of the individual, family or group. Evaluation of floor plans; arrangement of furniture.

INB 322 Interior planning 322
Academic organisation: Consumer Science
Prerequisite: ERG 282, ITW 311 and OBG 111
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 11
Module content:
The planning and designing of living and working spaces to provide for the different needs of the client. Visual and oral presentations for clients.

INB 410 Interior planning 410
Academic organisation: Consumer Science
Prerequisite: CIL 122 and INB 322
Contact time: 1 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 23
Module content:
Advanced interior planning.

INK 110 Interior production 110
Academic organisation: Consumer Science
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 9
Module content:
Basic and more advanced construction and sewing techniques; use of various sewing machines and materials in the construction of selected interior products.

INK 210 Interior production 210
Academic organisation: Consumer Science
Prerequisite: INK 110
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 10
Module content:
Evaluation of ready-made interior products; measuring, planning and construction of custom made interior products: window coverings, upholstery and assorted furnishings.

INK 310 Interior production 310
Academic organisation: Consumer Science
Prerequisite: INK 210
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 11
Module content:
A study of fashion and market trends in interior textile products. Development of a sample file. Exposure to mass production of selected interior products.

IPO 380 Interior experiential training 380
Academic organisation: Consumer Science
Prerequisite: INK 310 and ITW 311
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 8
Module content:
Controlled experiential training. During the third year of study, during holidays, weekends and after hours, students must complete a total of 120 hours experiential training in the industry to develop practical and occupational skills. This is equal to 3 weeks x 40 hours (120 hours), according to requirements as determined by the head of department. This exposure must be successfully completed together with a final report before the degree will be conferred.

ITP 481 Project: Interior merchandise 481
Academic organisation: Consumer Science
Prerequisite: Final-year status, INB 322, INB 410 # and SEM 381 GS
Contact time: 1 ppw 1 lpw
Period of presentation: Year
Language of tuition: Double Medium **Credits:** 22
Module content:
Project to illustrate the ability to integrate relevant theory in the planning and presentation of an interior merchandise project for specific clients.

ITW 121 Interior merchandise 121
Academic organisation: Consumer Science
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2

Language of tuition: Double Medium **Credits:** 8
Module content:
Household material and equipment studies: Metals and non-metals used for the manufacturing of objects, equipment and components of appliances for household use. Study and evaluation of selected non-electrical household equipment in terms of specific end-use situations.

ITW 221 Interior merchandise 221
Academic organisation: Consumer Science
Prerequisite: ITW 121
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 10
Module content:
Equipment studies: study of major and portable electrical household appliances in terms of consumer needs, specific end use situations, running and life cycle costs, sustainability aspects and environmental concerns to facilitate consumer decision making.

ITW 261 Interior merchandise 261
Academic organisation: Consumer Science
Contact time: 2 lpw 1 ppw
Period of presentation: Quarter 3
Language of tuition: Double Medium **Credits:** 5
Module content:
Equipment studies: study of selected major and portable electrical household appliances in terms of consumer needs, specific end use situations, running and life cycle costs, sustainability aspects and environmental concerns to facilitate consumer decision making.

ITW 311 Interior merchandise 311
Academic organisation: Consumer Science
Prerequisite: ITW 121
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 11
Module content:
A study of furniture (case goods and upholstered), floor coverings, wall finishes, lighting and household textile products in terms of construction techniques, composition, properties, quality indicators, advantages and disadvantages, appearance, durability, cost and maintenance and care factors.

KEP 220 Cultural eating patterns 220
Academic organisation: Consumer Science
Prerequisite: VDS121
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
Origin and development of food habits; Factors influencing food habits and choice; Dynamics of food habits. Influence of religion on food habits. Food habits of different ethnic groups. The influence of culture on cuisines. Study of the cuisines of selected African, European and Eastern countries.

KEP 261 Cultural eating patterns 261
Academic organisation: Consumer Science
Prerequisite: VDS121
Contact time: 3 lpw
Period of presentation: Quarter 3
Language of tuition: Double Medium **Credits:** 6
Module content:
Origin and development of food habits; Factors influencing habits and choice; Dynamics of food habits. Influence of religion on food habits. Food habits of different ethnic groups.

KLD 210 Costume and fashion history 210
Academic organisation: Consumer Science
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 12
Module content:
Costume and fashion history: Appearance characteristics of Western dress. Influencing factors. Evolution of styles from Ancient Egyptian up to and including the present.

KLD 222 Fashion forecasting 222
Academic organisation: Consumer Science
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
The South African fashion industry: Basic principles of fashion; fashion as a product; and the consumer.
Fashion production: Haute Couture and ready-to-wear clothes. Fashion forecasting and fashion analyses.

KLD 322 Social and cultural aspects of clothing 322
Academic organisation: Consumer Science
Contact time: 4 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 20
Module content:
Social-Psychological and cultural aspects of clothing: Development of a framework; Symbolic-Interaction as a framework; the cognitive approach. Development of the self: self and self-concept: the body as indicator; personal values and norms. Appearance management and presentation of the self: role acceptance, identity, social control, roles in social cognition. Cultural context and dress: reflection of human adaptation; culture creations (technical, moral and ceremonial patterns); societies and clothing; beauty standards and beauty ideals.
Social context, identity, change and clothing: the family, politics, religion, economy and the role of clothing as a reflection of social and personal identities; mentefacts and identities; social change and clothing.

KLD 410 Clothing retail management 410
Academic organisation: Consumer Science
Prerequisite: Fourth-year status
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 15
Module content:
Clothing retail and marketing aspects: Fashion marketing communication; clothing ranges; textiles, footwear and accessories merchandise characteristics; customer service; packing and packaging. Global interdependence: Appreciation of cultural differences; respect for diversity; trade agreements and implications; understanding of import/export regulations.

KLD 420 Clothing merchandising 420
Academic organisation: Consumer Science
Prerequisite: Fourth-year status
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 15
Module content:
Clothing merchandise managerial aspects: planning, purchasing, control; search for suppliers; relationship with suppliers; management roles and responsibilities; technology; ethical and legal behaviour. Visual merchandising: basic components; tools and techniques; planning. Retail and wholesale: Introduction: factors influencing stock movement; redistribution of stock; merchandising processes. Planning stock movement; factors influencing buying strategies.

KLR 110 Clothing production: sewing techniques 110
Academic organisation: Consumer Science
Contact time: 1 dpw 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 9
Module content:
A study of sewing appliances and equipment and the handling and use of different types of fabric. Functional and creative sewing techniques; grading and quality assurance.

KLR 120 Clothing production: processes 120
Academic organisation: Consumer Science
Prerequisite: KLR 110
Contact time: 1 lpw 1 dpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 9
Module content:
Processes (collars, pockets, buttonholes, fasteners, belts, hems, etc.)
Application: Unstructured, multi-sized garment.

KLR 211 Flat pattern design 211
Academic organisation: Consumer Science
Prerequisite: KLR 120
Contact time: 2 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 12
Module content:
Flat pattern design. Production design (flat pattern design + CAD).

KLR 221 Pattern use and good fit 221
Academic organisation: Consumer Science
Prerequisite: KLR 211
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 10
Module content:
Pattern use and good fitting.

KLR 311 Tailoring 311
Academic organisation: Consumer Science
Prerequisite: KLR 211 and KLR 221
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 11
Module content:
Tailoring.

KLR 321 Clothing production 321
Academic organisation: Consumer Science
Prerequisite: KLR 221
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 11
Module content:
Small scale production: Industrial machines, production systems, quality assurance.

KLR 411 Product development 411
Academic organisation: Consumer Science
Prerequisite: KLR 221 and KLR 321
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 19
Module content:
Production: product analysis, planning and execution. Application clothing, textile and consumer knowledge by utilising a CAD-program for planning and assembling apparel. The small business enterprise: Introduction: clothing small business enterprises; types and locations. Marketing aspects: target market selection; product mix; pricing methods; distribution channels; marketing communication mix; financial aspects.

KTP 220 Experiential training 220
Academic organisation: Consumer Science
Contact time: 1 ppw 1 dpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 4
Module content:
Compulsory practical training in the clothing industry during the year, approved in consultation with the head of the department.

KTP 402 Clothing textile project 402
Academic organisation: Consumer Science
Prerequisite: Fourth-year status and SEM 381
Contact time: 1 dpw 1 ppw
Period of presentation: Year
Language of tuition: Double Medium **Credits:** 18
Module content:
Project in field of application: planning and execution.

KVK 420 Small stock science 420
Academic organisation: Animal and Wildlife Sciences
Prerequisite: RPL 320, VGE 301 and VKU 220
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
Small stock management, shearing organisation, sheds and equipment, pens, dipping, drinking and feeding facilities. Preparation and marketing of hides, mohair and karakul. Lambing seasons and herd management. Management programmes for the production of wool, meat, karakul pelt and mohair according to the particular ecological region and for conditions of drought. Herd health programmes.

LBU 260 Agroclimatology 260
Academic organisation: Plant Production and Soil Science
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
*This module may only be taken by students enrolled for a BSc(Agric) programme Climate in Southern Africa. Irradiation and energy balance. Hydrological cycle with special reference to downpour and evaporation from vegetative surfaces. Windbreaks and frost control. Influence of climate on farming systems. Instrumentation and measurement of downpour, evaporation, radiation, temperature, humidity and wind.

LEK 220 Agricultural economics 220
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: [LEK 251 and LEK 252] or [EKN 113 and/or EKN 120]
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
The agribusiness system; the unique characteristics of agricultural products; marketing functions and costs; market structure; historical evolution of agricultural marketing in South Africa. Marketing environment and price analysis in agriculture: Introduction to supply and demand analysis.
Marketing plan and strategies for agricultural commodities; market analysis; product management; distribution channels for agricultural commodities, the agricultural supply chain, the agricultural futures market.

LEK 251 Introduction to financial management in agriculture 251
Academic organisation: Agricultural Economics, Extension and Rural Development
Contact time: 3 lpw
Period of presentation: Quarter 1
Language of tuition: Double Medium **Credits:** 6
Module content:
Introduction to financial management in agriculture: Farm management and agricultural finance, farm management information; analysis and interpretation of farm financial statements; risk and farm planning. Budgets: partial, break-even, enterprise, total, cashflow and capital budgets. Time value of money.

LEK 252 Introduction to agricultural production economics 252
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 251
Contact time: 3 lpw
Period of presentation: Quarter 2
Language of tuition: Double Medium **Credits:** 6
Module content:
Introduction to production and resource use: the agricultural production function, total physical product curve, marginal physical product curve, average physical product curve, stages of production. Assessing short-term business costs; Economics of short-term decisions. Economics of input substitution: Least-cost use of inputs for a given output, short-term least-cost input use, effects of input price changes. Least-cost input use for a given budget. Economics of product substitution. Product combinations for maximum profit. Economics of crop and animal production.

LEK 310 Agricultural economics 310
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: [LEK 251 or EKN 110] and [LEK 252 or EKN 120]
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Historical evolution of South African agricultural policy. Agriculture and the state: reasons for government intervention. Theoretical aspects of agricultural policy. Introduction to agricultural policy analysis. Welfare principles, pareto optimality. Macroeconomic policy and the agricultural sector. International agricultural trade.

LEK 320 Agricultural economics 320
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 220, LEK 251 and LEK 252
Contact time: 3 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 18
Module content:
The modern food and agribusiness system: The financing decision: capital acquisition, different capital sources, capital structures. The investment decision and working capital management. Strategic marketing. Operational management and human resources management.

LEK 415 Agricultural economics 415
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: EKN 110, LEK 220 and WTW 134
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 18
Module content:
Derivative instruments in agriculture: To prepare students for taking the SAFEX Agricultural Markets Division brokerage exam. Giving an in-depth knowledge on the importance of hedging. Giving an in-depth knowledge on designing and implementation of low/zero risk hedging strategies. Introduction to the mathematics of portfolio management and mathematical modelling of derivatives. Working knowledge of the mathematical relationships in the management of a hedged portfolio. Working

knowledge on the applicable software for managing derivative portfolios. Introduction into the management of option portfolios. To expand the thinking on the uses of derivatives, by also dealing with the hedging of diesel cost, interest rates and weather events.

LEK 421 Agricultural economics 421
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 451, STK 210 and STK 281
Contact time: 2 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 24
Module content:
Price and production function analysis. Input -output, input -input and product -product relationships; profit maximization; the production process through time, economies of size; decision making in agriculture under risk and uncertain circumstances; linear programming.

LEK 424 Introduction to resource economics 424
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 251 and LEK 252
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
This module reviews the origins and evolution of natural and environmental resource economics and its present-day main paradigms. Sources of externalities and causes of environmental degradation are examined. An introduction to the concepts and methods backing the design and implementation of environmental policies are provided. Economic valuation of natural and environmental resources is introduced.

LEK 451 Agricultural demand-and-supply analysis 451
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 220, LEK 252 and STK 281
Contact time: 3 lpw 2 ppw
Period of presentation: Quarter 1
Language of tuition: Double Medium **Credits:** 12
Module content:
This module will focus on the demand and supply shifters as well as the elasticities, flexibilities, and impact multipliers. After providing an appropriate background in the theoretical concepts of demand and supply these basics will be applied in the generation of econometric simulation models. Practical experience in the formulation of these models will be attained from practical sessions. The student will submit a project in which he/she must analyse the demand or supply patterns of a commodity of his/her choice by generating an econometric model.

LEK 452 Commodity price analysis 452
Academic organisation: Agricultural Economics, Extension and Rural Development
Prerequisite: LEK 220, LEK 252, LEK 451and STK 281
Contact time: 2 ppw 3 lpw
Period of presentation: Quarter 2
Language of tuition: Double Medium **Credits:** 12
Module content:
This module will focus primarily on price determination under different market structures, which will be followed by practical sessions on measuring market structures in various ways. This will include the calculation of market concentration. Some time will also be spent on measuring price changes by using indexes, and especially seasonal indexing. All of this will be supported by the relevant practical sessions. The relevance of changes to the main macroeconomic indicators will be discussed through out this course.

LKM 450 Environmental biophysics 450
Academic organisation: Plant Production and Soil Science
Prerequisite: WTW 134
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Environmental variables. Quantitative description and measurement of atmospheric environmental variables and water in organisms. Mass and energy fluxes. Quantitative description of energy fluxes in organisms' environments. Energy balances of animals and plant communities will be derived.

LST 133 Language, life and study skills 133
Academic organisation: Natural and Agricultural Sciences Dean's Office
Prerequisite: As for Four-year programme
Contact time: 1 lpw Foundation Course 3 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
In this module students use different information and time management strategies, build academic vocabulary and examine learning styles, multiple intelligences, and memory as well as practise academic reading skills and explore basic research and referencing techniques. The work is set in a science context.

LST 143 Language, life and study skills 133
Academic organisation: Natural and Agricultural Sciences Dean's Office
Prerequisite: LST 133
Contact time: Foundation Course 1 lpw 3 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
In this module students examine and compare academic and popular writing. Students are taught how to use discourse markers and how to structure their own academic arguments. Students' writing is expected to be rational, clear and concise. As a final assignment all aspects of the LST 133 and LST 143 courses are combined in a research assignment. In this project, students work in writing teams to produce both a chapter on a science career and an oral presentation of aspects of the chapter.

MAT 151 Differentiation of functions of one variable 151
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MPR 193 and MPR 194
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Functions, limits and continuity. Differential calculus of single variable functions, rate of change, curve sketching, applications. The mean value theorem, the rule of L'Hospital. Elementary functions: Exponential functions and their derivatives, logarithmic functions and their derivatives, inverse trigonometric functions, hyperbolic functions, indeterminate forms.

MAT 152 Linear algebra 152
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MPR 193 and MPR 194
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Geometry of the two and three-dimensional Euclidean spaces: Vectors, dot and cross products, lines and planes. Euclidean m-spaces, systems of linear equations, row reduction of linear systems, linear dependence and independence, subspaces, basis and dimension.
Matrices: Operations on matrices, matrix equations and inverses, determinants, Cramer's rule, rank of a matrix

MAT 161 Integration of functions of one variable 161
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 151
Contact time: 2 dpw 3 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 8
Module content:
Definite and indefinite integrals, the fundamental theorem of Calculus, the mean value theorem for integrals Integration techniques: Integration by parts, trigonometric integrals and substitution, approximate integration and improper integrals, areas and distance. Elementary power series and Taylor's theorem. Parametric equations and polar coordinates.

MAT 162 Applications of integration 162
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 161
Contact time: 2 dpw 3 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 8
Module content:
Applications of integration: Areas between curves, volumes, volumes by cylindrical shells, work, average value of a function. Further applications of integration: Arc length, area of a surface of revolution. Differential equations: Modelling with differential equations, direction fields and Euler's method, separable equations, linear equations. Vector functions and multivariable functions.

MAT 251 Functions of several variables and vector calculus 251
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 152
Contact time: 4 lpw 2 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 20
Module content:
Parametric equations, vector functions, space curves and arc lengths. Quadric surfaces, calculus of multivariable functions, partial derivatives, directional derivatives. Extrema and Lagrange multipliers. Multiple integrals, polar, cylindrical and spherical coordinates. Line integrals and the theorem of Green.
Vector calculus: Surface integrals and the theorems of Gauss and Stokes

MAT 261 Linear algebra 261
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 152
Contact time: 2 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 11
Module content:
Vector spaces: Vector spaces and subspaces, linear independence, basis and dimension, coordinate vectors, inner product spaces. Linear transformations: Algebra of linear transformations, kernel and image, matrix of a general linear transformation, change of basis.
Eigenvalues and eigenvectors, diagonalization.

MAT 262 Infinite sequences and series 262
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 161
Contact time: 2 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 11
Module content:
Series of functions, power series and Taylor series.

MAT 351 Real analysis 351
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 251 and MAT 262
Contact time: 1 dpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Topology of finite dimensional spaces: Open and closed sets, sequences, compactness, and completeness. Theorems of Bolzano-Weierstrass and Heine-Borel. Properties of continuous functions and applications. Sequences and series of functions.

MAT 352 Abstract algebra 352
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 261
Contact time: 1 dpw 3 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 15
Module content:
Groups: Definition and examples, permutation group of a set, symmetry of a figure, subgroups, cyclic groups and dihedral groups, homomorphisms and isomorphisms. Quotient groups: Equivalence relations, cosets and Lagrange's theorem, normal subgroups and quotient groups, isomorphism theorems.Rings and fields: Rings, integral domains and fields, subrings and ring homomorphisms, polynomial rings, polynomial and Euclidean rings (division algorithm, Euclidean algorithm, unique factorization, factoring real and complex polynomials, factoring rational and integral polynomials). Geometrical constructions: Constructable numbers, constructability and extensions of Q, constructability and polynomials, classical problems.

MAT 361 Complex analysis 361
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 251 and MAT 262
Contact time: 1 dpw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Complex functions, Cauchy-Riemann equations, Cauchy's theorem and integral formulas.
KMS states. Laurent series, residue theorem and application to calculating of integrals.

MAT 362 Numerical analysis 362
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: MAT 251 and MAT 261
Contact time: 1 dpw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 15
Module content:
Errors and floating point arithmetic. Roots of nonlinear equations: Bisection, Newton’s method and the secant method, routines for zero finding, non-linear systems of equations. Systems of linear equations: Gauss elimination with partial pivoting, matrix factorisation, matrices with special structure, numerical differentiation and integration.

MBY 161 Introduction to microbiology 161
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MLB 111 GS
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
The module will introduce the student to the field of Microbiology. Basic Microbiological aspects that will be covered include introduction into the diversity of the microbial world (bacteria, archaea, eukaryotic microorganisms and viruses), basic principles of cell structure and function, microbial nutrition and microbial growth and growth control.

Applications in Microbiology will be illustrated by specific examples i.e. bioremediation, animal-microbial symbiosis, plant-microbial symbiosis and the use of microorganisms in industrial microbiology. Wastewater treatment, microbial diseases and food will be introduced using specific examples.

MBY 251 Growth diversity and control of bacteria 251
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MBY 161 GS
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
Envelope of gram positive and gram negative rods. Growth of bacteria, replication of the genome, regulation of septum formation, diversity of cell division mechanisms across the prokaryotes, bacterial survival structures. Control of bacterial growth; classes of antibacterial agents, cellular targets for growth inhibition and killing of cells. Energy sources, harvesting from light versus oxidation, regulation of catabolic pathways, chemotaxis. Nitrogen metabolism, iron-scavenging. Alternative electron acceptors: denitrification, sulphate reduction, methanogenesis. Structure and function versus phylogenetics. Biodiversity; bacteria occurring in the natural environment (soil, water and air), associated with humans, animals, plants, and those of importance in foods and in the water industry.

MBY 261 Growth activity and control of fungi 261
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MBY 161
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
Organisation and molecular architecture of fungal thalli, chemistry of the fungal cell. Mechanisms, quantification, regulation of and chemical and physiological requirements for growth, nutrient acquisition, primary metabolism; secondary metabolism; regulation of metabolism; mating and meiosis; spore development; spore dormancy, dispersal and germination. Classes of antifungal agents, cellular targets for inhibition and killing of cells. Fungi as saprobes in soil, air, plant, aquatic and marine ecosystems; role of fungi as decomposers and in the deterioration of materials; fungi as predators and parasites; mycoses, mycetisms and mycotoxicoses; fungi as symbionts of plants, insects and animals. Applications of fungi in biotechnology.

MBY 351 Structure and diversity of viruses 351
Academic organisation: Microbiology and Plant Pathology
Prerequisite: [BCM 253 and BCM 254] and CMY 127 and MBY 161
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Introduction to the viruses as a unique kingdom inclusive of their different hosts, especially bacteria, animals and plants; RNA and DNA viruses; viroids, tumour viruses and oncogenes, mechanisms of replication, transcription and protein synthesis; effect on hosts; viral immunology; evolution of viruses.

MBY 352 Environmental microbiology 352
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MBY 161
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Basic principals in microbial ecology; microbial evolution, microbial interactions, ecosystems and communities, gene transfer, abiotic factors and extreme environments, microbial habitats which include air, water, soil, man, insects, animals and plants. The role of micro-organisms in biogeochemical cycling and microbial food webs. Potential exploitation of extreme environments, organisation of native populations in extreme environments, ecological aspects of deterioration control, soil, waste and water management.

MBY 353 Vertebrate-microbe interaction 353
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MBY 251
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Normal interactions between humans or animals and micro-organisms; Host-pathogen interactions; Principles of pathogenesis; Important infectious diseases of man and animals; Principles of diagnostics; Introduction to epidemiology.

MBY 354 Veterinary virology 354
Academic organisation: Microbiology and Plant Pathology
Prerequisite: [BCM 253 and BCM 254] and CMY 127 and MBY 161
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 9
Module content:
*Capita selecta only for BVSc programme
Introduction to viruses important in veterinary science; mechanisms of virus replication, transcription and protein synthesis; effect on hosts; viral immunology; epidemiology and evolution of viruses; prions; diagnoses and control of viral diseases and viral vaccines.

MBY 361 Trends in microbiology 361
Academic organisation: Microbiology and Plant Pathology
Prerequisite: [BCM 253 and BCM 254] and GTS 261 and MBY 251
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Biotechnological advances and gene-based innovations in Microbiology: Microbial diagnostics and epidemiology; microbial biosensors; vaccinology and therapeutic agents; biological control of plant pathogens; microbial diversity and bioprospecting; and bioremediation. Regulation, intellectual property rights and patenting in biotechnology.

MBY 362 Food microbiology 362
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MBY 251
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Food microbiology: different organisms involved, their isolation, screening and improvement. Microbial quality and spoilage of food: meat, poultry, seafood, dairy products, fruits, vegetables and grains. Microbial food safety: foodborne pathogens, microbes and public health. Protective measures: preservation. Food fermentations: fermentation types, principles and organisms involved. Product extraction, downstream processing, examples: dairy, beer, wine, amino acids, enzymes, traditional products. Microbiological examination of foods: Conventional approaches, alternative methods; rapid methods. Controlling food quality: Microbiological criteria, GMPs, HACCP, Risk analysis.

MBY 363 Molecular biology of prokaryotes 363
Academic organisation: Microbiology and Plant Pathology
Prerequisite: [BCM 253 and BCM 254] and CMY 127 and MBY 161
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Modification of genetic material: DNA damage and damage repair, photoreactivation, SOS response. Mobile elements, insertion sequences, transposons. Control of operons and regulons, negative control, positive control, mixed control, regulation by upstream DNA structure, sigma factors, the role of recombination in expression, regulation of translation, DNA-protein interactions. Posttranslational control and modifications of proteins: allosteric control, covalent modifications, posttranslational control by compartmentalisation. Global regulatory networks, carbon catabolyte repression, alarmones, signal transduction, chemotaxis, regulation of fermentation and respiration, stress responses, adaptation to extreme environments. Folding of proteins, protein export, repair of damaged proteins.

MBY 364 Genetic manipulation of microbes 364
Academic organisation: Microbiology and Plant Pathology
Prerequisite: [BCM 253 and BCM 254] and CMY 127 and MBY 161
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Isolation of clonable DNA (genomic libraries, cDNA synthesis) cloning vectors (plasmids, bacteriophages, cosmids) plasmid incompatibility and control of copy number. Ligation of DNA fragments, modification of DNA end and different ligation strategies. Direct and indirect methods for the identification of recombinant organisms. Characterization (polymerase chain reaction, nucleic acid sequencing) and mutagenisis of cloned DNA fragments. Gene expression in Gram negative (E.coli) Gram positive (B.subtilis) and yeast cells (S.cerevisea). Use of Agrobacterium and baculoviruses for gene expression in plant and insect cells respectively. Applications in protein engineering, diagnostics and synthesis of useful products.

MLB 111 Molecular and cell biology 111
Academic organisation: Genetics
Contact time: 4 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Introductory study of the ultra structure, function and composition of representative cells and cell components. General principles of cell metabolism, molecular genetics, cell growth, cell division and differentiation.

MLB 133 Molecular and cell biology 133
Academic organisation: Plant Science
Prerequisite: As for BSc Four-year programme
Contact time: 2 lpw 2 ppw 2 dpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
The scientific method, the meaning of life, principles of microscopy, chemistry of the cell, introductory study of the structure, function and composition of akaryotes, HIV/aids, the immune system and other health issues, ecosystems and human interference.

MLB 143 Molecular and cell biology 143
Academic organisation: Plant Science
Prerequisite: MLB 133
Contact time: 2 dpw Foundation Course 2 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Biochemistry of the cell, introduction to the structure, function and composition of prokaryotic and eukaryotic cells, introduction to taxonomy and systematics, energy and cellular metabolism, photosynthesis.

MLB 153 Molecular and cell biology 153
Academic organisation: Genetics
Prerequisite: MLB 143
Contact time: 2 tpw 2 ppw Foundation Course 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Cell growth and cell division, Mendelian and human genetics, principles of molecular genetics, principles of recombinant DNA technology and its application.

MTT 210 Furniture and textile history 210
Academic organisation: Consumer Science
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 12
Module content:
Influences of ideologies, social institutions and technology on the development of Western and other material cultures, especially on furniture and textiles. Style periods from Egyptian to the French Revolution.

MTT 220 Furniture and textile history 220
Academic organisation: Consumer Science
Prerequisite: MTT 210 GS
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
Influences of ideologies, social institutions and technology on the development of Western and other material cultures, especially on furniture and textiles. Style periods from early nineteenth century to the present.

NLB 311 Ecosystems and wildlife management 311
Academic organisation: Animal and Wildlife Sciences
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 4
Module content:
NLB 311 and NLB 312 are presented over a period of 21 days as one integrated module. Both modules are aimed at students of wildlife management and veterinary sciences. These study programmes offer an exciting, hands-on, in-depth educational experience, taking students behind the scenes in the wildlife field in Southern Africa.
The training takes part during a camping and lodging expedition. Students interact with wildlife biologists, rangers, veterinarians and researchers working in the field, giving them an insight into the successes and problems associated with conservation from both an ecological and veterinary perspective. Participants also meet and learn from pioneers in game capture and those actively involved in the field of wildlife veterinary science on a day-to-day basis. The students also participate in actual game capture operations. Students also study and observe the role that veterinarians play at a wildlife rehabilitation centre, a reptile park and a rare-species breeding ranch.
Module content
- Wildlife management techniques
- Sustainable resource utilization
- Ecosystem and biodiversity conservation
- Reserve and resort management
- African local community cultures and conservation perspectives
- Capture and care of wild animals
- Wildlife disease management
- Population dynamics

NLB 312 Participatory nature conservation 312
Academic organisation: Animal and Wildlife Sciences
Contact time: 6 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 4
Module content:
NLB 311 and NLB 312 are presented over a period of 21 days as one integrated module. Both modules are aimed at students of wildlife management and veterinary sciences. These study programs offer an exciting, hands-on, in-depth educational experience, taking students behind the scenes in the wildlife field in Southern Africa.
The training takes part during a camping and lodging expedition. Students interact with wildlife biologists, rangers, veterinarians and researchers working in the field, giving them an insight into the successes and problems associated with conservation from

both an ecological and veterinary perspective. Participants also meet and learn from pioneers in game capture and those actively involved in the field of wildlife veterinary science on a day-to-day basis. The students also participate in actual game capture operations. Students also study and observe the role that veterinarians play at a wildlife rehabilitation centre, a reptile park and a rare-species breeding ranch.
Module content

- Wildlife management techniques
- Sustainable resource utilization
- Ecosystem and biodiversity conservation
- Reserve and resort management
- African local community cultures and conservation perspectives
- Capture and care of wild animals
- Wildlife disease management
- Population dynamics

OBG 111 Design principles 111
Academic organisation: Consumer Science
Contact time: 1 ppw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 7
Module content:
Introduction to basic concepts in design (design elements and principles) and practical application in interior planning and design, foods and clothing. Theories of colour.

OKW 413 Weed science 413
Academic organisation: Plant Production and Soil Science
Prerequisite: PLG 251
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
Identification of important weeds of crops, gardens and recreational areas.
Identification of alien invasive and indigenous encroaching species. Impacts of weeds on desirable vegetation. Interference between crop and weed species through allelopathy and competition phenomena. Role of weeds in plant-biodiversity and crop production potential. Weeds in annual and perennial crop situations. Weed biology and ecology. Mechanical, cultural, biological and chemical weed management practices. Integrated weed management. Herbicide formulations and application techniques. Modes of action of herbicides, and their behaviour and fate in the environment.

OPI 480 Experiential training in industry 480
Academic organisation: Consumer Science
Contact time: 1 dpw
Period of presentation: Year
Language of tuition: Double Medium **Credits:** 6
Module content:
Experiential training in the industry: During the 4 years of study, during holidays, weekends and after hours, students must complete a total of 480 hours experiential training in the industry to develop practical and occupational skills. This is equal to 3 weeks x 40 hours (120 hours) per year, according to requirements as determine by the head of department. This training must be successfully completed together with a complete portfolio before the degree will be conferred

PGB 410 Project: Research methodology 410
Academic organisation: Consumer Science
Prerequisite: Final year status
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 10
Module content:
Research methodology. Planning, executing and reporting a research project in Hospitality Management.

PGB 420 Project: Hospitality management 420
Academic organisation: Consumer Science
Prerequisite: PGB 410 and Final year status
Contact time: 4 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 20
Module content:
Research methodology. Planning, executing and reporting a research project in Hospitality Management.

PGW 350 Soil-water relationship and irrigation 350
Academic organisation: Plant Production and Soil Science
Prerequisite: GKD 250
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Quantitative description and measurement of soil water content and potential as well as saturated and unsaturated hydraulic conductivity. Modelling water flow in soil (Darcy's law, Richards's equation). Infiltration, redistribution, evaporation, runoff and percolation. Irrigation in South Africa. Modelling and managing the soil water balance. Plant water consumption and the soil-plant-atmosphere continuum. Irrigation scheduling (soil, plant and atmosphere approaches). Managing poor quality water. Irrigation systems. The module includes a field trip to an irrigation scheme.

PGW 400 Seminar 400
Academic organisation: Plant Production and Soil Science
Contact time: 1 lpw 3 spw
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 20
Module content:
Basic principles of the scientific process. Literature accessing and article assessment. Manuscript preparation and presentation of seminars. Basic instruction on the use of visual aids, etc. for effective oral presentations.

PGW 421 Experimental design and analysis 421
Academic organisation: Plant Production and Soil Science
Prerequisite: BME 120
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 1

Language of tuition: Both Afr and Eng **Credits:** 14

Module content:
Basic experimental designs. Measurement and control over experimental error. Factorial experiments and interactions. Analysis of variance (ANOVA) and data interpretation.

PHY 131 General physics 131
Academic organisation: Physics
Prerequisite: Refer to Regulation 1. 2
Contact time: 4 lpw 1 dpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
*This course is intended for students who require only a single semester of physics. Students who have passed the PHY131 course but would prefer to continue with the PHY171 year course, will have to do an additional course. This change can only be made after approval by the head of the department.
Units, vectors, one dimensional kinematics, dynamics, work, equilibrium, sound, liquids, heat, electric potential and capacitance, direct current and alternating current, optics, modern physics, radio activity.

PHY 133 Physics 133
Academic organisation: Physics
Prerequisite: As for BSc Four-year programme
Contact time: Foundation Course 2 dpw 2 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Heat: temperature and scales, the kinetic molecular model, work, energy and heat, calorimetry, specific heat, expansion, heat transfer. Measurements: SI-units, measuring error and uncertainty, (graphs), significant figures, mathematical modelling. Geometrical optics: reflection, refraction, dispersion, mirrors, thin lenses, instruments.

PHY 141 General physics 141
Academic organisation: Physics
Prerequisite: PHY 131 GS as well as 50% minimum for the practical component of PHY 131 or TDH
Contact time: 1 lpw 2 tpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
*This is an anti-semester presentation of the module PHY 131 General Physics 131. Refer to PHY 131 for the content description. Students will not be credited for both PHY 131 and PHY 141 for degree purposes.

PHY 143 Physics 143
Academic organisation: Physics
Prerequisite: PHY 133
Contact time: 2 dpw Foundation Course 2 ppw 2 lpw
Period of presentation: Semester 2

Language of tuition: English **Credits:** 8
Module content:
Waves: sound, intensity, superposition, interference, standing waves, resonance, beats, Doppler effect. Physical optics: Young-interference, coherence, thin layers, diffraction, gratings, polarisation. Hydrostatics and dynamics: density, pressure, Archimedes' law, continuity, Bernouli.

PHY 153 Physics 153
Academic organisation: Physics
Prerequisite: PHY 143
Contact time: 3 lpw 2 ppw 2 dpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Vectors. Kinematics of a point: relative, projectile, circular motion. Dynamics: Newton's laws, friction. Work: point masses, gases (ideal gas law), gravitation, spring, power. Kinetic energy. Potential energy: conservative forces, gravitation, spring, conservation of mechanical energy and energy, conservation of momentum. Impulse and collisions. System of particles: centre of mass, Newton's laws. Rotation: torque, conservation of angular momentum, equilibrium, centre of gravity.

PHY 163 General physics 163
Academic organisation: Physics
Prerequisite: PHY 153
Contact time: 1 ppw 4 lpw Foundation Course 1 dpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 8
Module content:
*This module corresponds to the second half of the PHY 171 module. The four modules PHY 133, PHY 143, PHY 153 and PHY 163 are equivalent to PHY 171.
Simple harmonic motion and pendulums. Coulomb's law. Electric field : dipole, Gauss' law. Potential. Capacitance. Electric currents: resistance, resistivity, Ohm's law, energy, power, semiconductors, superconductors, emf, RC-circuits. Magnetism : Hall effect, Biot-Savart law. Faraday's and Lenz's laws. LR-circuits. Alternating current : RLC-circuits, power transformers. Modern physics: Theory of special relativity, wave/particle nature, photoelectric effect, matter waves, quantum theory, infinite potential well, hydrogen atom and spectra, nuclear physics, Rutherford model, nucleons.

PHY 171 First course in physics 171
Academic organisation: Physics
Prerequisite: Refer to Regulation 1.2
Contact time: 1 dpw 1 ppw 4 lpw
Period of presentation: Year
Language of tuition: Double Medium **Credits:** 32
Module content:
SI-units. Significant figures. Waves: sound, intensity, superposition, interference, standing waves, resonance, beats, Doppler. Geometrical optics: Reflection, refraction, dispersion, mirrors, thin lenses, instruments. Physical optics: Young-interference, coherence, thin layers, diffraction, gratings, polarisation. Hydrostatics and dynamics: density, pressure, Archimedes' law, continuity, Bernouli. Heat: temperature and scales, specific heat, expansion, heat transfer. Vectors. Kinematics of a point: relative, projectile, and circular motion. Dynamics: Newton's laws, friction. Work: point masses, gases (ideal gas law), gravitation, spring, power. Kinetic energy. Potential energy: conservative forces, gravitation, spring. Conservation of mechanical energy and energy. Conservation of momentum. Impulse and collisions. System of particles: centre of mass, Newton's laws. Rotation: torgue, conservation of angular momentum, equilibrium, centre of gravity. Simple harmonic motion and pendulums. Coulomb's law. Electric field: dipole, Gauss' law. Potential. Capacitance. Electric currents: resistance, resistivity, Ohm's law, energy, power, semiconductors, superconductors, emf, RC-circuits. Magnetism: Hall effect, Biot-Savart. Faraday's and Lenz's laws. LR-circuits. Alternating current: RLC-circuits, power, transformers. Modern physics: Theory of special relativity, wave/particle nature, photoelectric effect, matter waves, quantum theory, infinite potential well, hydrogen atom and spectra, nuclear physics, Rutherford model, nucleons.

PHY 255 Waves, thermodynamics and modern physics 255
Academic organisation: Physics
Prerequisite: [PHY 171 or PHY 143 and PHY 153 and PHY 163] and WTW 211 # and WTW 218 #
Contact time: 1 ppw 2 dpw 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 24
Module content:
Vibrating systems and waves (12 lectures)
Simple harmonic motion (SHM). Superposition (different frequencies, equal frequencies). Perpendicular vibrations (Lissajous figures). Damped SHM. Forced oscillations. Resonance. Q-value. Transverse wave motion. Plane wave solution using method of separation of variables. Reflection and transmission at a boundary. Normal and eigenmodes. Wave packets. Group velocity.
Modern physics (30 lectures)
Special relativity: Galilean and Lorentz transformations. Postulates. Momentum and energy. 4 vectors and tensors. General relativity. Quantum physics. Failure of classical physics. Bohr model. Particle-wave duality. Schrödinger equation. Piece-wise constant potentials. Tunneling. Hydrogen atom. Angular momentum. Spin. X-rays. Laser. Nuclear physics: Fission. Fusion. Radioactivity.
Heat and thermodynamics (14 lectures)
Heat. First Law. Kinetic theory of gases. Mean free path. Ideal, Clausius, Van der Waals and virial gases. Entropy. Second Law. Engines and refrigerators. Third Law. Thermodynamic potentials: Enthalpy Helmholtz and Gibbs free energies, Chemical

potential. Legendre transformations (Maxwell relations). Phase equilibrium. Gibbs phase rule.
Modelling and simulation
Introduction to programming in a high level system: Concept of an algorithm and the basic logic of a computer programme. Symbolic manipulations, graphics, numerical computations. Applications: Selected illustrative examples.

PHY 263 General physics 263
Academic organisation: Physics
Prerequisite: PHY 255 GS, WTW 211 GS, WTW 218 GS, WTW 220 # and WTW 221 #
Contact time: 4 lpw 2 ppw 2 dpw
Period of presentation: Semester 2

Language of tuition: English **Credits:** 24
Module content:
Classical mechanics (28 lectures)
Mechanics of deformable matter: Fluids. Pascal's Law. Archimedes' Law. Bernoulli equation. Elasticity. Bulk and Young's modulus. Shear. Fundamental concepts: Space and time. Newton's Laws. One-dimensional motion. Conservative forces. Conservation of energy. Motion near equilibrium. Collision problems, Energy and angular momentum: Energy. Conservative forces. Torque, angular momentum. Central forces. Hamilton's principle and Lagrange's equations. Central conservative forces: Conservation laws. Inverse square force. Orbits equation. Scattering cross sections. Impact parameter. Rotating frames: Angular velocity. Rate of change of a vector. Apparent gravity. Coriolis force. Precession of elliptic orbit around centre of force. Two Body problem: Centre-of-mass and relative coordinates - also Lagrange equations. The centre-of-mass frame (P, J and T). Many body systems: Momentum and centre of mass (CM) motion. Angular momentum and moments of internal forces. Kinetic and potential energy. Lagrange equations in CM and relative coordinates.
Physical optics (14 lectures)
Electromagnetic Theory: Maxwell equations - simplified form for uniform transverse fields. Wave equation and plane-wave solutions. Electromagnetic character of light. Spherical waves. Waves at an interface: Fresnel equations. Evanescent waves. Conducting media. Complex index or refraction. Polarization: Law of Malus. Jones vectors and matrices. Crystal optics: Dielectric tensor. Index ellipsoid and surfaces. Characteristic waves. Uniaxial crystals. Interference: Superposition of vector fields, wave-front splitting, amplitude splitting. Thin-film stacks - matrix methods. Diffraction: Huygens principle. Fraunhofer approximation. Single and double slit. Diffraction grating.
Physics of materials (14 lectures)
Classification of materials. Atomic bonding. Crystallography. Point defects and diffusion. Line defects. Material strength. Phase diagrams. Ceramics. Polymers. Composites. Fracture. Electrical properties. Semiconductors. Surface physics. Smart materials. Nanotechnology.

PHY 353 Physics project 353
Academic organisation: Physics
Prerequisite: TDH
Contact time: 3 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
*Cannot be used as substitute for other Physics 300 modules to obtain admission to the BSc(Hons) in Physics.
A student is required to complete a project under guidance of the lecturer. The nature of the project is determined jointly by the student, lecturer and the head of department.

PHY 356 Electronics, electromagnetism and quantum mechanics 356
Academic organisation: Physics
Prerequisite: PHY 255 GS, PHY 263 GS, WTW 211 GS and WTW 218 GS
Contact time: 1 ppw 4 lpw 2 dpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 36
Module content:
Electronics
Thévenin and Norton equivalent circuits, superposition principle, RC, LC and LRC circuits. Semiconductor diode. Bipolar transitor. Operational amplifiers. Computer controlled instrumentation.
Electromagnetism:
Electrostatics: Coulomb's law, divergence and curl of E, Gauss' law, Laplace's equation, image charge problems, multipole expansion.
Magnetostatics: Lorenz force, Biot-Savart law, divergence and curl of magnetic field strength, Ampère's law, magnetic vector potential, multipole expansion, boundary conditions.
Electrodynamics: Electromotive force, electromagnetic induction, Maxwell's equations, wave equation.
Electric and magnetic fields in matter: Polarisation, electric displacement and Gauss's law in dielectrics, linear dielectrics. Magnetisation (diamagnets, paramagnets, ferromagnets), auxiliary field H and Ampère's law in magnetised materials, linear and nonlinear media.
Quantum mechanics:
The mathematical and conceptual basis of Wave Mechanics: de Broglie hypothesis and the de Broglie atom. Complex vector spaces, basis vectors, operators, eigenequations. Function spaces, delta function, Fourier series and transforms, wave packets, statistical interpretation, Schrödinger equation, Heisenberg's uncertainty principle.
One-dimensional applications: free particle, potential wells and barriers. Eigenvalues obtained through operator methods, harmonic oscillator. Three- dimensional applications: Schrödinger equation in Cartesian and spherical coordinates, angular momentum eigenvalues, 3D box, 3D oscillator spectrum. Matrix methods and spin.

PHY 363 Physics project 363
Academic organisation: Physics
Prerequisite: TDH
Contact time: 3 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
*Cannot be used as substitute for other Physics 300 modules to obtain admission to the BSc(Hons) in Physics
A student is required to complete a project under guidance of the lecturer. The nature of the project is determined jointly by the student, lecturer and the head of department.

PHY 364 General physics 364
Academic organisation: Physics
Prerequisite: PHY 356 GS, WTW 221 and WTW 218
Contact time: 2 dpw 4 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 36
Module content:
Statistical mechanics (32 lectures)
Isolated systems in thermodynamical equilibrium. Systems in equilibrium with a heat bath: the canonical ensemble, Gibbs' entropic formula, classical statistical mechanics, energy equipartition theorem, heat capacity of classical ideal gases, heat capacity of solids. Einstein's model. Debye's model, black body radiation, paramagnetism.
The classical limit of perfect gases: Gibbs paradox and the non-distinguishable character of quantum particles, Sackur-Tetrode entropic formula, the equation of state of the classical ideal gas. Quantum perfect gases: the grand canonical ensemble, Fermi-Dirac distribution, the free electron gas in metals, the Bose-Einstein distribution, Bose-Einstein condensation.
Solid state physics (24 lectures)
Crystallography: waves in crystals, diffraction.
Thermal lattice vibrations: the Debye model. Phonons in non-metals, thermal conductivity, scattering mechanisms for phonons.
Free electrons in crystals: free-electron theory and distribution of the electrons amongst the energy states. Electrical conductivity and the band theory: scattering mechanisms.
Semiconductors: effective mass, doping and Fermi levels.
Physics of the p-n junction: applications, low dimensional systems, heterojunctions.
Magnetism: Paramagnetism, susceptibility, L-S coupling and Hund's rules, Curie's law. Ferromagnetism, hysteresis. Antiferromagnetism. Ferrimagnetism.
Dielectric properties: microscopic theory of the dielectric constant, piezoelectricity, dielectric breakdown.
Superconductivity: Meissner effect, origin of superconductivity, isotope effect.
Physics modelling (Assessment will be done through a portfolio of project reports)
Modelling of physical systems.

PLG 251 Introduction to crop protection 251
Academic organisation: Microbiology and Plant Pathology
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 12
Module content:
Development and importance of crop protection. Basic principles in crop protection i.e. epidemic development of disease and insect pest populations, ecology of plant diseases and abiotic factors that affect plant health i.e. environmental pollution and pesticides, nutrient deficiencies and extreme environmental conditions. Ecological aspects of plant diseases, pest outbreaks and weed invasion. Important agricultural pests and weeds. Life cycles of typical disease causing organisms. Basic principles of integrated pest and disease management.

PLG 262 Principles of plant pathology 262
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MBY 161
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
Fundamental principles of plant pathology. The concept of disease in plants. Causes of plant diseases. Stages in development of plant diseases. Disease cycles. Diagnosis of plant diseases.

PLG 351 General plant pathology 351
Academic organisation: Microbiology and Plant Pathology
Prerequisite: MBY 161 and MBY 261 or TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 18
Module content:
Principles and examples of plant diseases and their socio-economic importance. Introductory aspects of phytobacteriology and plant virology. Current trends in plant pathology such as biosecurity, sanitory and phytosanitary issues of trade. Risk assesment and international food safety standards. The use of global information systems to assess disease spread and impact of global warming. Supply chain analysis, postharvest technology and food trade aspects.

PLG 363 Plant disease control 363
Academic organisation: Microbiology and Plant Pathology
Prerequisite: PLG251 or PLG262 or TDH. MBY261 is recommended
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Principles of plant disease control. Non-chemical control including biological control, disease resistance, regulatory measures, cultivation practices, physical methods. Modern chemo-therapy: characteristics, mode of action and application of fungicides, bactericides and nematicides. Principles of integrated disease management.

PLG 364 Host pathogen interactions 364
Academic organisation: Microbiology and Plant Pathology
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Includes fungal, bacterial and viral interactions. Focuses on molecular and cellular events occurring during recognition, during fungal evasion of the host's defence mechanisms and during disease symptom development. Topics discussed will also include cell biology of interactions, systemic acquired resistance and the role of pathogenesis related proteins and toxins in pathogenesis. Basic aspects of plant disease epidemiological theory and concepts. Introduction to equipment and techniques used in epidemiological research as well as practical applications of epidemiology in plant disease management.

PLG 462 Research project 462
Academic organisation: Microbiology and Plant Pathology
Contact time: 1 ppw 1 lpw
Period of presentation: Year
Language of tuition: Double Medium **Credits:** 30
Module content:
A practical research project of limited extent under the supervision of one of the lecturers in plant pathology within the department. Any topic in plant pathology can be selected.

PLG 483 Advanced plant disease control 483
Academic organisation: Microbiology and Plant Pathology
Prerequisite: PLG 363 or TDH
Contact time: 2 dpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 18
Module content:
Advanced aspects of chemical and biological control of plant diseases as well as disease resistance.

PLG 490 Current concepts in plant pathology 490
Academic organisation: Microbiology and Plant Pathology
Prerequisite: Third-year status or TDH
Contact time: 1 dpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
This module will address the most recent concepts in plant pathology.

PPK 251 Sustainable production systems 251
Academic organisation: Plant Production and Soil Science
Prerequisite: BOT 161
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Sustainability in plant production. Principles and practices of monoculture, crop

rotation, ley cropping and intercropping systems. Organic farming. Precision farming. Concepts such as target yield, maximum economic yield and the farming systems approach. Principles of soil cultivation and conservation.

PVK 420 Poultry science 420
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VGE 301 and VKU 220
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 12
Module content:
Industrial science and management of production systems and feeding systems in poultry production units. Applied breeding of poultry. Design and utilization of equipment and housing facilities. Product quality and marketing of poultry products. Hygiene and health programmes.

RFI 110 Radiation physics 110
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: Afrikaans **Credits:** 10
Module content:
Units: converting, dimensional analysis. Mechanics: momentum, force, energy, circular motion, moment of inertia, angular momentum, simple harmonic motion.
Electrostatics: Coulomb's law, electric field, potential. Direct currents: resistors, Ohm's law. Capacitors: capacitance, series, parallel energy. Magnetism: force on a moving charge, electric motor. Electromagnetic induction: Faraday's law, Lenz's Law, generators. Alternating currents: average and rms value, three phase, rectification, transformers. Electrical safety. Atomic structure: ionization, excitation.
X-rays: production, absorption.

RFI 210 Radiation physics 210
Academic organisation: Physics
Prerequisite: RFI 110, MTL 180, RAN 100, FSG 161, FSG 162, RAW 182 and RAW 180
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Afrikaans **Credits:** 7
Module content:
X-ray generator: transformer, energy losses, rectifiers, capacitor-discharge systems, kVp and mA control, high voltage cables. Image intensifiers: design, brightness gain, coupling systems. TV camera and monitor: design, video signal, scanning. Image quality. Optics: reflection, refraction, total internal reflection, mirrors, lenses, thin lens formula, lens aberrations, fiber optics, lasers, laser camera. Computers: basic hardware, digital principles and terminology, data storage.

RFI 211 Radiation physics 211
Academic organisation: Physics
Prerequisite: RFI 110, RAW 180, RAN 100, FSG 161, FSG 162, RAW 182 and MTL 180
Contact time: 4 lpw
Period of presentation: Semester 2
Language of tuition: Afrikaans **Credits:** 6
Module content:
Radio-active decay: half-life, alfa decay, beta decay, gamma decay. Production of isotopes cyclotron, nuclear reactor, Van de Graaff accelerator. Absorption: nucleons, alfa particles, beta particles. Dosimetry: exposure, absorbed dose, equivalent dose, effective dose, dose limits. Radiation detectors: Geiger counter, scintillation counter, thermoluminescent detector, semi-conductor detectors. Radiopharmaceuticals. Biological effects: genetic and somatic effects.

RFI 310 Radiation physics 310
Academic organisation: Physics
Prerequisite: FSG 251, RFI 210, RAW 281, RBG 281, RAN 280, RAW 282, FSG 252, FSG 262, RAW 284 and RFI 211
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Afrikaans **Credits:** 7
Module content:
Computed tomography: CT generations. Equipment: x-ray tube, collimators, detectors. Image reconstruction: fundamental equations, algorithms. Image properties: field size, image matrix, voxel, pixel, CT number, window width and height. Image quality: spatial resolution, contrast resolution, quantum mottle, spatial uniformity and frequency. Image processing: edge enhancement, pixel shifting and subtraction. Digital radiography: X-ray, equipment, analog to digital conversion, linear and logarithmic subtraction, image noise. Ultrasound: theory, transducers, piezo-electric crystals, resonant frequency, interaction with matter, acoustic impedance, Doppler techniques. Magnetic resonance: medical applications.

RPL 310 Reproduction science 310
Academic organisation: Animal and Wildlife Sciences
Prerequisite: DAF 200
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Theriogenology, spermatogenesis, zoogenesis, the female sexual cycle. Species differences. Hormonal control of the sexual functions.

RPL 320 Reproduction science 320
Academic organisation: Animal and Wildlife Sciences
Prerequisite: RPL 310
Contact time: 1 ppw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 10
Module content:
Artificial insemination. Semen collection techniques, the evaluation, dilution and conservation of semen. Collection, conservation and transfer of embryos. Collection of

ova and in vitro fertilization. Handling of apparatus and practical insemination, oestrus observation and determination of gestation.

SCE 171 Religious instruction 171
Academic organisation: Physics
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Prominent religions in South Africa, world views associated with these religions, the cultural role of religions, importance of holy days. Mysticism and the occult.

SCE 201 Science education 201
Academic organisation: Physics
Contact time: 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 16
Module content:
An introduction to patterns of scientific thinking. An introduction to science and science literacy. Ethics of science. Using the scientific method to encourage discovery learning. Exploring the concept of knowledge. The Learning Cycle. Principles of curriculum design.

SCE 204 Educational community project 204
Academic organisation: Natural and Agricultural Sciences Dean's Office
Contact time: 2 other per week
Period of presentation: Year
Language of tuition: English **Credits:** 12
Module content:
*SCE 304 and SCE 204 may not both be taken for credit for degree purposes.
Students must demonstrate the ability to facilitate learning with particular emphasis on the application of team teaching, planning and implementation. Evaluation includes an essay by the student teacher, evaluation reports from a supervisor and participants. Additionally, the student teacher presents a report to peers in the form of a seminar. This contributes two weeks to Teaching Practice.

SCE 301 Educational community project 301
Academic organisation: Natural and Agricultural Sciences Dean's Office
Prerequisite: SCE 303 # or TDH
Contact time: 2 other per week
Period of presentation: Year
Language of tuition: English **Credits:** 18
Module content:
*SCE 304 and SCE 204 may not both be taken for credit for the degree purposes.
Students must demonstrate the ability to facilitate learning with particular emphasis on the application of team teaching, negotiation for resources, planning and implementation. It is expected that students perform continuous assessment using a variety of methods. Evaluation includes a portfolio and an essay by the student teacher, evaluation reports from a supervisor and participants. Additionally, the student teacher presents a report to peers in the form of a seminar. This contributes two weeks to Teaching Practice.

SCE 303 Science education 303
Academic organisation: Physics
Prerequisite: CIL 111 GS
Contact time: 1 ppw 2 lpw
Period of presentation: Year
Language of tuition: English **Credits:** 36
Module content:
Understanding the application of OBE in the teaching of science. The infusion of scientific thinking into the science curriculum in a developmentally appropriate way. The design of learning programmes by programme organisers at school level. Macro planning in the natural science learning area. Provincial and national models of assessment. The assessment and implementation of learning programmes. The assessment of learner progress in the context of specific science learning programmes. Introduction to the principles of discipline and motivation. Some aspects of school guidance and career planning. Practical: Practical experience with learning opportunities. Use of computers as a teaching aid.

SCI 154 Exploring the universe 154
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 16
Module content:
The content of this course is the same as SCI 164 and students are not allowed to register for both SCI 154 and SCI 164.
Students from all faculties are welcome to join us in our exploration of the universe from an earth-bound perspective. We reflect on the whole universe from the sub microscopic to the vast macroscopic and mankind's modest position therein. To what degree is our happiness determined by stars? Echo's from ancient firmaments - the astronomy of old civilisations. The universe is born with a bang. Stars, milky ways and planets are formed. Life is breathed into the landscape on earth, but is there life elsewhere? The architecture of the universe – distance measurements, structure of our solar system and systems of stars. How does it look like on neighbouring planets? Comets and meteorites. Life cycles of stars. Spectacular exploding stars! Exotica like pulsars and black holes.

SCI 164 Exploring the universe 164
Academic organisation: Physics
Contact time: 4 lpw
Period of presentation: Semester 2
Language of tuition: Afrikaans **Credits:** 16
Module content:
*This module is presented in Afrikaans only. See SCI 154 for a summary of the module content. The content of this module is the same as SCI 154 and students are not allowed to register for both SCI 154 and SCI 164.

SEM 381 Seminar 381
Academic organisation: Consumer Science
Prerequisite: Third year status
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 5
Module content:
Introduction to research methodology.

SGM 210 Geomaterials and processes 210
Academic organisation: Geology
Contact time: 4 lpw 3 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Solar system; Earth structure and systems; plate tectonics; classification and contextual setting of rocks and minerals; rock cycle. Internal and external geological processes; landscape formation; influences of geological environment on mankind. Geological time and the Earth's history through time. Practicals involving identification and description of crystals, minerals and rocks.

SUR 210 Surveying 210
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and levelling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

SUR 220 Surveying 220
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2

Language of tuition: Double Medium **Credits:** 16
Module content:
Adjustment and use of following instruments: Plane table, level, compass and theodolite. Elementary site surveying and leveling, tachometry. Definition of survey. Co-ordinate systems and bearing. Connections and polars. Methods of determining points. Elevation. Tachometry.

TKS 211 Textiles: Utility 211
Academic organisation: Consumer Science
Contact time: 1 ppw 3 lpw
Period of presentation: Quarter 1
Language of tuition: Double Medium **Credits:** 7
Module content:
Utility aspects: basic components of textiles, consumer decision-making, utility aspects that include durability, comfort, maintenance, health/safety/protection and aesthetic aspects.

TKS 212 Textiles: Utility, fibres and yarns 212
Academic organisation: Consumer Science
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 14
Module content:
Utility aspects: basic components of textiles, consumer decision making, utility aspects that include durability, comfort, maintenance, health/safety/protection and aesthetic aspects. Fibres and yarns: Fibre structure and performance including textile chemistry, fibre morphology and formation, fibre properties, classification and identification. Yarn structure and performance (including spun yarns, filament yarns, compound and novelty yarns).

TKS 222 Textiles: Structures and finishes 222
Academic organisation: Consumer Science
Prerequisite: TKS 212 GS
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 14
Module content:
Fabric structures: Introduction to fabric structures. Woven fabrics, knits, non-woven fabrics and compound fabrics. Finishes and dyeing processes: Introduction to fabric finishing. Preparatory and final finishes. Finishes for special end-uses: durability, comfort and protection; ease of maintenance; aesthetic appeal. Dyed and printed fabrics.

TKS 310 New developments and textiles in use 310
Academic organisation: Consumer Science
Prerequisite: TKS 212 and TKS 222 GS
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 10
Module content:
New developments (apparel textiles). Textile product use. Impact of textiles on ecology and sustainability.

TKS 421 Textiles 421
Academic organisation: Consumer Science
Prerequisite: TKS 212, TKS 222 and TKS 310
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 15
Module content:
Clothing textiles and textile products from a marketing and consumer perspective. Practical project: Project to assess performance properties of textiles for specific end-use by using laboratory tests. A written report of the results is also required.

TLR 320 Animal breeding 320
Academic organisation: Animal and Wildlife Sciences
Prerequisite: GTS 261
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 10
Module content:
Karyotyping of farm animals; breed and specie differences and the influence on classification of breeds. Influence of chromosomal aberrations. Phenotypic expression of genes and gene-interaction in farm animals. Single gene, major genes and polygenes. Variation in traits of economic importance and statistical description. Use of genetic variation. Estimation of breeding values and family indices on traits determined by single genes. Principles of breeding systems.

TLR 411 Animal breeding 411
Academic organisation: Animal and Wildlife Sciences
Prerequisite: TLR 320 and simultaneously register for GVK 420, PVK420, KVK420 and VKD 410
Contact time: 2 lpw fortnightly practicals
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
Components of animal performance. Sources of variation, population parameters and the estimation thereof. Introduction to matrix algebra for application in animal breeding. Selection indices theory. Statistical models in estimation of breeding values.
Application of breeding values and prerequisites for accuracy. Breeding and selection for reproduction and growth. Principles of QTLs.

TLR 420 Animal breeding 420
Academic organisation: Animal and Wildlife Sciences
Prerequisite: TLR 411
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
Formulation and application of breeding objectives. Animal recording systems and international guidelines for evaluation. Specie- specific breeding systems. Traits of economic impotence and the efficiency there off. Crossbreeding systems in meat producing farm animals. Breed development.

TRN 213 Site surveying 213
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 12
Module content:
General surveying; instruments, their handling and adjusting; surveying systems and simple calculations; determining of levels; setting out of the works; tacheometry and plotting; scales, planimetry; areas and volumes; construction surveying; aerial photography.

VBF 411 Consumer facilitation 411
Academic organisation: Consumer Science
Contact time: 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 10
Module content:
Consumer decision making through the family life cycle; determinants of consumer satisfaction. Consumer education; development of consumer skills; less privileged consumers. Expenditure patterns of the diverse South African consumer market. Consumerism. Globalisation.

VDB 321 Food service management 321
Academic organisation: Consumer Science
Prerequisite: Natural and Agricultural Sciences students: VDS 322 #
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Planning and layout of food service units for different food service systems. Equipment for food services. Factors influencing the choice and purchasing of equipment for different food service units. Hygiene and safety in food services. management in food service systems. Financial management in food services.

VDB 410 Food service management 410
Academic organisation: Consumer Science
Prerequisite: VDB 321 GS
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 24
Module content:
The professional food service manager's roles, responsibilities and characteristics. Contemporary leadership and management styles in food service systems. Professionalism and ethics. Advanced food service systems and production management techniques. Marketing of food services.

VDG 220 Nutrition 220
Academic organisation: Consumer Science
Contact time: 3 lpw
Period of presentation: Semester 2

Language of tuition: Double Medium **Credits:** 12
Module content:
Integration of natural science concepts basic to the study of human nutrition. Cell and tissue; energy metabolism and balance; body temperature; cardiovascular system; kidneys and acid-base equilibrium.

VDG 260 Nutrition 260
Academic organisation: Natural and Agricultural Sciences Dean's Office
Prerequisite: CMY127
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 12
Module content:
Nutrition in the context of growth, development and composition of organisms. Metabolic processes and control in the body. Overview of nutritional processes. The study of the fundamental principles of nutrient metabolism (including macro- and micro-nutrients and water) and digestion physiology. Applications are made regarding man and animals.
Practical work: Experimental work and problem orientated tasks.

VDG 311 Nutrition 311
Academic organisation: Consumer Science
Prerequisite: [FSG 110 and FSG 120] or VDG 220
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 17
Module content:
The study of nutrients and water regarding their chemical composition, characteristics, basic digestion, absorption, metabolism, functions, food sources and symptoms of deficiency and toxicity. Energy metabolism. Dietary recommendations and guidelines, dietary guides and meal planning. The use and application of food composition tables in dietary analysis.

VDG 321 Nutrition during life cycle 321
Academic organisation: Consumer Science
Prerequisite: VDG 311
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 17
Module content:
The role of nutrition in the life cycle. The role of nutrition in the prevention of lifestyle related diseases - osteoporosis, cancer, coronary heart disease, tooth decay. Vegetarianism. Different conditions of malnutrition: Protein energy malnutrition and obesity.

VDS 111 Basic food preparation 111
Academic organisation: Consumer Science
Contact time: 0.5ppw 1 ppw 1 dpw 1 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 6
Module content:
Basic food preparation and food preparation techniques. Weighing and measurement techniques, equipment and terminology as applied in food preparation. Basic food quality control.

VDS 121 Basic food preparation 121
Academic organisation: Consumer Science
Prerequisite: VDS 111
Contact time: 1 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 6
Module content:
Basic food preparation and food preparation techniques. Weighing and measurement techniques, equipment and terminology as applied in food preparation. Basic food quality control.

VDS 210 Food commodities and preparation 210
Academic organisation: Consumer Science
Prerequisite: VDS 121
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 18
Module content:
The study of different food systems with regard to food preparation. Physical and chemical properties and the influence of the composition in food preparation. Food preparation basics of the following: soups and sauces; fruit and vegetables; salads; frozen desserts; gelatine.

VDS 221 Food commodities and preparation 221
Academic organisation: Consumer Science
Prerequisite: VDS 210
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
The study of different food systems with regard to food preparation. Physical and chemical properties and the influence of the composition in food preparation. Food preparation basics of the following: meat; poultry; fish, legumes, eggs and milk, starches and cereals; baked products (whole spectrum); leavening agents.

VDS 310 Consumer food research 310
Academic organisation: Consumer Science
Prerequisite: VDS 221
Contact time: 1 ppw 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 21
Module content:
Planning executing and reporting consumer food research. Food preservation and evaluation techniques. Experiments in food, emphasizing ingredient function and standard preparation methods. Application of experimental methods through which the chemical and physical reactions of food to different food handling, preparation and preservation techniques are illustrated. Quality evaluation and consumer orientated sensory evaluation of food products.

VDS 322 Large-scale food production and restaurant management 322
Academic organisation: Consumer Science
Prerequisite: Natural and Agricultural Sciences students: [KEP 261 or KEP 220] and VDS 221
Health Sciences students: KEP 261, VDS 210 and VDS 221
Contact time: 3 ppw 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 29
Module content:
Module 1 and practical work: Principles of large-scale food preparation and the practical application thereof in a practical restaurant situation. Restaurant management. Recipe formats and adjustment applicable to large-scale food preparation. Work scheduling and the practical exposure to the use of large scale catering equipment in a real life situation.
Module 2: Menu planning for different food service systems and styles of food service.
Module 3: Large scale food procurement, consumption and storage.

VDS 354 Food safety and hygiene 354
Academic organisation: Consumer Science
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 14
Module content:
Principles of food safety and food hygiene. Consumer rights and protection.

VDS 355 Food and beverage service management 355
Academic organisation: Consumer Science
Prerequisite: VDS 221
Contact time: 2 lpw 1 ppw
Period of presentation: Quarter 1
Language of tuition: Double Medium **Credits:** 6
Module content:
Table setting, table serving, wine service, food and wine pairing, beverage management.

VDS 413 Recipe development and standardisation 413
Academic organisation: Consumer Science
Prerequisite: VDS 310 or VDS 322
Contact time: 3 lpw 2 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 30
Module content:
Recipe development process. Development of appropriate recipes and food products for a given situation. Standardisation of recipes. Food styling and food photography.

VDS 414 Culinary art 414
Academic organisation: Consumer Science
Prerequisite: VDS 210 and VDS 221
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 19
Module content:
Advanced food preparation and presentation techniques.

VDS 415 Visual merchandising of foods 415
Academic organisation: Consumer Science
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 15
Module content:
Aspects of food retailing with special emphasis on food packaging and labelling of food products. Aspects of food retailing with regard to display, presentation and shop layout as applied to food products.

VDS 423 Foods 423
Academic organisation: Consumer Science
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 15
Module content:
Factors influencing food consumption, consumer behaviour and food choice. Food product advice. Consumer advice, marketing of food products, consumer education.

VDS 424 Culinary art 424
Academic organisation: Consumer Science
Prerequisite: VDS 221, VDS 322 # and VDS 414
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 19
Module content:
Advanced food preparation and presentation techniques. Event planning and banqueting.

VDS 425 Project: Foods visual merchandising of foods 425
Academic organisation: Consumer Science
Prerequisite: VDS 415 and VDS 423
Contact time: 3 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 15
Module content:
Practical application of the principles in visual merchandising of food and food retailing in the food industry.

VDS 426 Food research project 426
Academic organisation: Consumer Science
Prerequisite: PGB 410 # and VDS 310
Contact time: 1 lpw 2 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Planning, executing and reporting a research project in a food related field.

VGE 301 Nutrition science 301
Academic organisation: Animal and Wildlife Sciences
Prerequisite: [BCM 263 and BCM 264] and [BCM 265 and BCM 266] and DAF 200, VDG 250 or VDG 260 and VKU 220
Contact time: 3 lpw fortnightly practicals
Period of presentation: Year
Language of tuition: Both Afr and Eng **Credits:** 32
Module content:
Digestion and metabolism of feeds. The division of food energy and food energy systems. Protein quality and requirements. Mineral and vitamin requirements. Nutritional standards. Voluntary intake. Characteristics of fodder. Rumen function and microbial fermentation. Practical work: In vivo and in vitro digestibility studies.

VGE 411 Nutrition science 411
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VGE 301
Contact time: 4 lpw fortnightly practicals
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Specialised nutrition of monogastric animals: poultry, pigs, horses and selected freshwater aquatic organisms. The use of computer systems in feeding management.

VGE 421 Nutrition science 421
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VGE 301
Contact time: 3 lpw fortnightly practicals
Period of presentation: Semester 2
Language of tuition: English **Credits:** 16
Module content:
Specialized small stock and game nutrition. Nutrition of rams, ewes and lambs for optimal production. Principles of creep feeding, drought feeding, winter and supplementary feeding. Feeding pen nutrition and final nutritional preparation of lambs. Influence of nutrition on wood, pelts and Mohair. Fodder flow planning. Practical work: Formulation of lowest cost rations and practical work with ruminants.

VGE 423 Nutrition science 423
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VGE 301
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 16
Module content:
Specialised nutrition of beef and dairy cattle according to production systems. The use of computer systems in feeding management. The practicals will include compiling rations in terms of requirements and least cost formulations, specialised assignments and on-farm experiential training.

VKD 410 Pig science 410
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VGE 301, VKU 220 and LEK 210
Contact time: 1 lpw fortnightly practicals
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 8
Module content:
Industrial science and management of pigs - sow, boar and growing pigs. Production systems and feeding systems. Design and utilization of housing facilities. Product quality and marketing. Hygiene and herd health programmes.

VKF 411 Animal science pharmacology 411
Academic organisation: Animal and Wildlife Sciences
Prerequisite: DFS 320 and VGE 301
Contact time: 3 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 12
Module content:
The pharmacology, laws, control and use of substances for animal production.

VKU 120 Animal science 120
Academic organisation: Animal and Wildlife Sciences
Contact time: 2 lpw 0.5ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Origin and domestication of farm and companion animals. The ecological environment in which animal production and development is practised. Livestock species, breeds and breed characterisation and genetic variation. Terminology. Practical work includes identification and classification of different breeds of livestock.

VKU 210 Animal science 210
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VKU120
Contact time: 1 ppw 2 lpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 8
Module content:
Basic principles of nutrition, physiology, breeding and production. Applied principles of livestock production, production management and systems (large livestock, small

stock, pigs and poultry). Organisation of the livestock industry and relevant legislation. Animal handling. Practical work includes the general care and handling of farm stock.

VKU 220 Animal science 220
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VKU 210 GS of TDH
Contact time: 1 ppw 2 lpw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 12
Module content:
Livestock ecology, interaction between genotype and environment. Production regions and systems. Animal ecological factors that influence regional classification. Animal ecological factors to be considered in production factors, planning and management of different livestock production systems. Conservation farming and adapted farming and management systems; environmental conservation. Practical work will consist of compulsory farm practical during vacation after the 1st year and or during the 2nd year of study.

VKU 222 Animal science 222
Academic organisation: Animal and Wildlife Sciences
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 6
Module content:
The chemical composition of fodder. Digestive processes and the digestibility of fodder. The nutrition and nutritional requirements of farm stock. Basic composition of rations. Intensive and extensive feeding.

VKU 320 Animal science 320
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VKU 210, VKU 220 and WDE 310
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 12
Module content:
Functional management of intensive and extensive beef, dairy, sheep and goat production systems. Discussions and literature studies on applied animal nutrition, breeding production planning and production processes.

VKU 361 Animal ecology 361
Academic organisation: Animal and Wildlife Sciences
Prerequisite: TDH
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Animal ecology, interaction between genotype and environment. Animal-ecological factors which influence regional classification. Animal ecology factors which must be taken into consideration in the obtaining of the production factors, planning and management of the cattle farming enterprise. Conservation farming and adapted farming and management systems; environmental conservation.

VKU 362 Animal science biotechnology 362
Academic organisation: Animal and Wildlife Sciences
Prerequisite: GTS 261
Contact time: 1 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Application of biotechnology in farm animals with specific reference to reproductive biotechnology such as AI MOET and sex manipulation, which has an effect on genetic progress. Application of DNA technology such as parentage verifications, identification of genetic defects, QTL's and MAS.

VKU 400 Research methodology 400
Academic organisation: Animal and Wildlife Sciences
Prerequisite: Simultaneously register for GVK 420, PVK420, TLR411, VGE 423, VKF 411 and WLK 410
Contact time: 2 lpw 1 spw
Period of presentation: Year
Language of tuition: English **Credits:** 16
Module content:
Research methodology in animal science: Literature studies and seminars. Introduction to the problem, approach to problem solving, methodology and appropriate reporting. Practice.

VSX 420 Meat and dairy science 420
Academic organisation: Animal and Wildlife Sciences
Prerequisite: DFS 320
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 10
Module content:
Meat industry. Meat species. Composition of carcass and meat, slaughtering process, meat quality, and the consumer. Dairy industry. Composition and nutritional value of milk and factors that influence it. Milk production, milk quality and distribution.

VVW 350 Community nutrition and public health 350
Academic organisation: Human Nutrition
Prerequisite: HNT 210 or TDH and VDG 250 or VDG 260 and VDG 321
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 21
Module content:
Theory and practice of community nutrition and public health (capita selecta CNT 411). Environmental health issues and health indicators in communities.

VVW 363 Food, nutrition and health 363
Academic organisation: Consumer Science
Prerequisite: HNT210 or VDG311 and VDG321
Contact time: 3 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 21
Module content:
Scientific foundation of food and nutrition in health promotion and disease prevention. Principles of interpretation of nutritional assessment data.

VVW 364 Food composition and applied nutritional programmes 364
Academic organisation: Food Science
Prerequisite: FST 351 and FST 352 or TDH
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Generation, interpretation and application of food composition data in nutrition programmes. Chemical composition of foods: sampling for food analysis, assessing methods of food analysis for inclusion in food composition data. Interpretation of food composition data. Nutritional labeling of food. Use of nutritional data in food formulations. Dietary supplementation, enrichment and fortification of foods.

WDE 310 Principles of veld management 310
Academic organisation: Plant Production and Soil Science
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
The influence of biotic and abiotic factors on the productivity of different strata and components of natural pastures. This will enable the student to advise users, with the necessary motivation, on the appropriate use of these strata and components and will form a basis for further research on this system. The principles of veld management s and the influence of management practices on sustainable animal production from natural pastures. This will enable the student to advise users on veld management and veld management principles. It will also form a basis for further research on veld management.

WDE 320 Planted pastures and fodder crops 320
Academic organisation: Plant Production and Soil Science
Prerequisite: WDE 310
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 14
Module content:
The establishment and use of planted pastures species and fodder crops and the conservation of fodder. This will enable students to advise users on establishment and utilisation of planted pastures species as well as farmers on the production, conservation and optimum use of fodder. This will also form a basis for further research on planted pastures.

WDE 450 Environmental resource assessment and management 450
Academic organisation: Plant Production and Soil Science
Contact time: fortnightly practicals 3 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 20
Module content:
Determining the resource potential of land on the basis of botanical composition, vegetation cover, animal grazing and browsing potential, water quality, soil quality, chemical, physical and biological soil degradation, soil erosion and other important environmental processes etc. which are essential for integrated agricultural land use practices. Evaluation of grasses and other vegetation types in terms of environmental adaptation, acceptability and adaptability to a sustainable utilization system and the management requirements of an integrated and adaptive management system.

WKD 151 Atmospheric processes 151
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 8
Module content:
Weather and climate. Origin and composition of the atmosphere. Oxygen, carbon and life. Meteorological instruments. Temperature distribution and heat capacity. Atmospheric mass and pressure. Radiation. Zenith angle of the sun. Sunshine variability. The boundary layer. Heat transfer in the boundary layer. Atmospheric heat budget. Urban and rural climates. Equation of state. Air parcel theory. Phases of water and latent heat. Vapour and saturated vapour pressure. Dew point temperature and relative humidity. Dry adiabatic, wet adiabatic and environmental temperature lapse rates. Cloud development. Sensible heat. Comfort zones. Acquisition of data from the South African Weather Bureau: Composition and submission of a report.

WKD 152 Atmospheric circulation and climate 152
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw 1 ppw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 8
Module content:
Hadley and Walker (ENSO) cells. Convergence, divergence, convection and subsidence. Polar stratospheric ozone. Air parcel theory. Angular velocity of the earth. Gravitational, centrifugal forces: Gravity force. Pressure gradient force. Coriolis force. Friction force. Rotation of a cyclone and anti-cyclone. Geostrophic wind. Intertropical convergence zone (ITCZ). Monsoon rain. Mid-latitude cyclonic frontal systems. Cut-off low. Coastal lows. Jet streams. Tropical cyclones. Foehn effect. Climate and climate change. Typical circulation patterns over South Africa: Composition and submission of a report.

WKD 162 Dynamic and numerical meteorology 162
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 8
Module content:
Electromagnetic spectrum. Planck's constant. Radiation energy. Irradiance and radiance. Solar or electromagnetic energy and distance. Stefan Boltzman law. Solar constant. Solar energy received and emitted on a spherical Earth. Albedo. Black body radiation. Global energy balance. Equations for the pressure gradient and Coriolis forces. The Geostrophic wind. Introduction to finite difference methods. Numerical estimation of the geostrophic wind, vorticity and divergence. Advection of temperature. Development of a two-dimensional numerical temperature advection model: Composition and submission of a report.

WKD 164 Climate and weather of Southern Africa 164
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 8
Module content:
The climate of Southern Africa. Synoptic weather systems of Southern Africa. Classification of weather types. Synoptic and METAR messages. Weather data on the internet. Introduction to satellite images and synoptic charts.

WKD 250 Weather forecasting 250
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 24
Module content:
Understanding of all coded meteorological messages. Basic principles and interpretation of satellite imagery. Interpretation of aerological diagrams, dynamic and thermodynamic variables. Integration of information to describe the current state of the atmosphere and to predict a future state of the atmosphere.

WKD 253 Community project 253
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 2 ppw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 18
Module content:
Identification and execution of a community project with the aim to provide meteorological information to the general South African public. A project proposal including a budget will be drawn up before the project commences and a project report will be drawn up after completion of the project.

WKD 261 Physical meteorology 261
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 12
Module content:
Conservative forces and conservation laws. Basic thermodynamic laws for dry and humid air. The equation of state. Adiabatic processes and temperature lapse rates. The Clausuis-Claperon equation. Calculation of the wet adiabat.

WKD 351 Atmospheric balance laws 351
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 4 lpw 1 ppw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 18
Module content:
Acceleration in rotating co-ordinates, fundamental forces, momentum equation, one, two and three dimensional flow balance, conservation of mass, heat equation, thermodynamic energy equation.

WKD 352 Atmospheric vorticity and divergence 352
Academic organisation: Geography, Geoinformatics and Meteorology
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 18
Module content:
Scale analyses and simplification of the basic equations. The geostrophic, thermal and gradient wind. The vorticity equation and divergence.

WKD 361 Quasi-geostrophic analysis 361
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: WKD 351 GS # and WKD 352 GS #
Contact time: 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 18
Module content:
Tendency and Omega equations. Model of a boroclinic system. Introduction to numerical models.

WKD 362 Cloud and boundary layer dynamics 362
Academic organisation: Geography, Geoinformatics and Meteorology
Prerequisite: WKD 351 GS #
Contact time: 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
Introduction to cloud dynamics. Classification and development of clouds. Cumulonimbus clouds, super cell storms and tornadoes. Planetary boundary layer, atmospheric turbulence, Reynolds average, turbulent kinetic energy, the Ekman layer, secondary circulation.

WKE 420 Wildlife science 420
Academic organisation: Animal and Wildlife Sciences
Prerequisite: VGE 301 and VKU 361 or TDH
Contact time: 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 10
Module content:
Introductory aspects of wildlife conservation, habitat management, wildlife nutrition and keeping wildlife in zoological gardens.

WLK 410 Wool science 410
Academic organisation: Animal and Wildlife Sciences
Contact time: 1 lpw 0.5ppw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 8
Module content:
Development of follicles and growth of wool. The morphology, physical and chemical characteristics of wool fibre. The classing, marketing and processing of wool. Physical testing. Regulations with regard to the classing and packaging of wool. Class standards of the NWGA.
Practical: course in wool classing.

WTW 114 Calculus 114
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 1 tpw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*This module serves as preparation for students majoring in Mathematics (including all students who intend to enrol for WTW 218 and WTW 220). Students will not be credited for more than one of the following modules for their degree: WTW 114, WTW 158, WTW 134.
Functions, limits and continuity. Differential calculus of single variable functions, rate of change, graph sketching, applications. The mean value theorem, the rule of L'Hospital. Definite and indefinite integrals, the fundamental theorem of Calculus.

WTW 115 Discrete structures 115
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Propositional logic: truth tables, logical equivalence, implication, arguments. Mathematical induction and well-ordering principle. Introduction to set theory. Counting techniques: elementary probability, multiplication and addition rules, permutations and combinations, binomial theorem, inclusion-exclusion rule.

WTW 123 Numerical analysis 123
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114 GS
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Non-linear equations, numerical integration, initial value problems for differential equations, systems of linear equations. Algorithms for elementary numerical techniques are derived and implemented in computer programmes. Error estimates and convergence results are treated.

WTW 126 Linear algebra 126
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*This module serves as preparation for students majoring in Mathematics (including all students who intend to enrol for WTW 211).
Vector algebra with applications, matrix algebra, systems of linear equations, the vector space Rn, bases, determinants. Mathematical induction. Complex numbers and factorisation of polynomials.

WTW 128 Calculus 128
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114 GS
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*This module serves as preparation for students majoring in Mathematics (including all students who intend to enrol for WTW 218 and WTW 220).
Taylor's theorem, Riemann integral, integration techniques, improper integrals. Applications of integration. Parametric and polar equations. Vector functions of one variable. Scalar functions of several variables. Directional derivatives. Geometric meaning of the gradient.

WTW 133 Precalculus 133
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: As for BSc Four-year programme
Contact time: Foundation Course 1 ppw 1 tpw 5 lpw
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Real numbers, elementary set notation, exponents and radicals. Algebraic expressions, fractional expressions, linear and quadratic equations, inequalities. Coordinate geometry: lines, circles. Functions: definition, notation, piecewise defined functions, absolute value, domain and range, graphs, transformations of functions, symmetry, even and odd functions, combining functions, one-to-one functions and inverses, polynomial functions and zeros.

Sequences, summation notation, arithmetic, geometric sequences, infinite geometric series, annuities and instalments. Degrees and radians, unit circle, trigonometric functions, fundamental identities, trigonometric graphs, trigonometric identities, double-angle, half-angle formulae, inverse trigonometric functions, trigonometric equations, applications.

WTW 134 Mathematics 134
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 1 tpw 4 lpw
Period of presentation: Semester 1 or Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*Students will not be credited for more than one of the following modules for their degree: WTW 134, WTW 114, WTW 158. WTW 134 does not generally lead to admission to Mathematics at 200 level and is intended for students who require Mathematics at 100 level only. WTW 134 can also be taken in the second semester.
Functions, derivatives, interpretation of the derivative, rules of differentiation, applications of differentiation, integration, interpretation of the definite integral, applications of integration. Discrete probability, matrices, solutions of systems of equations. Markov chains.

WTW 143 Calculus 143
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 133
Contact time: 4 lpw 1 tpw Foundation Course 1 ppw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Functions: exponential and logarithmic functions, natural exponential and logarithmic functions, exponential and logarithmic laws, exponential and logarithmic equations, compound interest. Limits: concept of a limit, finding limits numerically and graphically, finding limits algebraically, limit laws without proofs, squeeze theorem without proof, one-sided limits, infinite limits, limits at infinity, vertical, horizontal and slant asymptotes, substitution rule, continuity, laws for continuity without proofs. Differentiation: average and instantaneous change, definition of derivative, differentiation rules without proofs, derivatives of polynomials, chain rule for differentiation, derivatives of trigonometric, exponential and logarithmic functions, applications of differentiation: extreme values, critical numbers, monotone functions, first derivative test, optimisation.

WTW 152 Mathematical modelling 152
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Introduction to the modelling of dynamical processes using difference equations. Curve fitting. Introduction to linear programming. Matlab programming. Applications to real-life situations in, among others, finance, economics and ecology.

WTW 153 Calculus 153
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 143
Contact time: 1 ppw 4 lpw 1 tpw Foundation Course
Period of presentation: Semester 1
Language of tuition: English **Credits:** 8
Module content:
Rigorous treatment of limits and continuity. Differential calculus of a single variable with proofs and applications. The mean value theorem, the rule of L'Hospital. Upper and lower sums, definite and indefinite integrals, the fundamental theorem of Calculus, the mean value theorem for integrals, integration techniques, with some proofs.

WTW 158 Calculus 158
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 1 tpw 4 lpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 158, WTW 114, WTW 134.
Introduction to vector algebra. Functions, limits and continuity. Differential calculus of single variable functions, rate of change, graph sketching, applications. The mean value theorem, the rule of L'Hospital. Indefinite integrals, integration.

WTW 161 Linear algebra 161
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: Refer to Regulation 1.2
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 161, WTW 126.
Vector algebra with applications, matrix algebra, systems of linear equations, the vector space Rn, bases, determinants. Mathematical induction. Complex numbers and factorisation of polynomials. Conic sections. This module also includes a formal technique mastering programme.

WTW 162 Dynamical processes 162
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW114 GS
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 8
Module content:
Introduction to the modelling of dynamical processes using elementary differential equations. Solution methods for first order differential equations and analysis of properties of solutions (graphs). Applications to real life situations.

WTW 168 Calculus 168
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114 GS or WTW 158 GS
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
*This module is designed for first-year engineering students. Students will not be credited for more than one of the following modules for their degree: WTW 168, WTW 128, WTW 138.
Integration techniques, improper integrals. The definite integral, fundamental theorem of Calculus. Applications of integration. Elementary power series and Taylor's theorem. Vector functions, space curves and arc lengths. Quadratic surfaces and multivariable functions.

WTW 211 Linear algebra 211
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 126
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
This is an introduction to linear algebra on Rn. Matrices and linear equations, linear combinations and spans, linear independence, subspaces, basis and dimension, eigenvalues, eigenvectors, similarity and diagonalisation of matrices, linear transformations.

WTW 218 Calculus 218
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114 and WTW 128
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Calculus of multivariable functions, directional derivatives. Extrema and Lagrange multipliers. Multiple integrals, polar, cylindrical and spherical coordinates. Line integrals and the theorem of Green. Surface integrals and the theorems of Gauss and Stokes.

WTW 220 Analysis 220
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114 and WTW 128
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Properties of real numbers. Analysis of sequences and series of real numbers. Power series and theorems of convergence. The Bolzano-Weierstrass theorem and the intermediate value theorem. Analysis of real-valued functions on an interval.

WTW 221 Linear algebra 221
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 211
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Abstract vector spaces, change of basis, matrix representation of linear transformations, orthogonality, diagonalisability of symmetric matrices, some applications.

WTW 238 Mathematics 238
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 256 and WTW 258 GS
Contact time: 2 tpw 4 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 16
Module content:
Linear algebra, eigenvalues and eigenvectors with applications to first and second order systems of differential equations. Sequences and series, convergence tests. Power series with applications to ordinary differential equations with variable coefficients. Fourier series with applications to partial differential equations such as potential, heat and wave equations.

WTW 256 Differential equations 256
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 158, WTW 161 and WTW 168
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 1
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Theory and solution methods for linear differential equations as well as for systems of linear differential equations. Theory and solution methods for first order non-linear differential equations. The Laplace transform with application to differential equations. Application of differential equations to modelling problems.

WTW 258 Calculus 258
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 158 and WTW 168
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 1

Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Calculus of multivariable functions, directional derivatives. Extrema. Multiple integrals, polar, cylindrical and spherical coordinates. Line integrals and the theorem of Green. Surface integrals and the theorems of Gauss and Stokes.

WTW 263 Numerical methods 263
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 161 and WTW 168
Contact time: 2 lpw 1 dpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Numerical integration. Numerical methods to approximate the solution of non-linear equations, systems of equations (linear and non-linear), differential equations and systems of differential equations. Direct methods to solve linear systems of equations.

WTW 285 Discrete structures 285
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 115
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Setting up and solving recurrence relations. Equivalence and partial order relations. Graphs: paths, cycles, trees, isomorphism. Graph algorithms: Kruskal, Prim, Fleury. Finite state automata.

WTW 286 Differential equations 286
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114, WTW 126 and WTW 128
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 12
Module content:
Theory and solution methods for ordinary differential equations and initial value problems: separable and linear first-order equations, linear equations of higher order, systems of linear equations. Application to mathematical models. Qualitative analysis of linear systems.

WTW 310 Analysis 310
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 220
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 18
Module content:
Topology of finite dimensional spaces: Open and closed sets, compactness, connectedness and completeness. Theorems of Bolzano-Weierstrass and Heine-Borel. Properties of continuous functions and applications. Integration theory for functions of one real variable. Sequences of functions.

WTW 320 Analysis 320
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 218 and WTW 310
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Series of functions, power series and Taylor series. Complex functions, Cauchy-Riemann equations, Cauchy's theorem and integral formulas. Laurent series, residue theorem and calculation of real integrals using residues.

WTW 354 Financial engineering 354
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WST 211, WTW 211 and WTW 218
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 18
Module content:
Mean variance portfolio theory. Market equilibrium models such as the capital asset pricing model. Factor models and arbitrage pricing theory. Measures of investment risk. Efficient market hypothesis. Stochastic models of security prices

WTW 364 Financial engineering 364
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WST 211, WTW 126, WTW 218 and WTW 286
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: English **Credits:** 18
Module content:
Discrete time financial models: Arbitrage and hedging; the binomial model. Continuous time financial models: The Black-Scholes formula; pricing of options and the other derivatives; interest rate models; numerical procedures.

WTW 381 Algebra 381
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114 and WTW 211
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 18
Module content:
Group theory: Definition, examples, elementary properties, subgroups, permutation groups, isomorphism, order, cyclic groups, homomorphisms, factor groups. Ring theory: Definition, examples, elementary properties, ideals, homomorphisms, factor rings, polynomial rings, factorisation of polynomials. Field extensions, applications to straight-edge and compass constructions.

WTW 382 Dynamical systems 382
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW218 and WTW286
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1

Language of tuition: Double Medium **Credits:** 18
Module content:
Matrix exponential function: homogeneous and non-homogeneous linear systems of differential equations. Qualitative analysis of systems: phase portraits, stability, linearisation, energy method and Liapunov's method. Introduction to chaotic systems. Application to real life problems.

WTW 383 Numerical analysis 383
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 114, WTW 128 and WTW 211
Contact time: 2 lpw 1 ppw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Direct methods for the numerical solution of systems of linear equations, pivoting strategies. Iterative methods for solving systems of linear equations and eigenvalue problems. Iterative methods for solving systems of nonlinear equations. Introduction to optimization. Algorithms for the considered numerical methods are derived and implemented in computer programmes. Complexity of computation is investigated. Error estimates and convergence results are proved.

WTW 385 Discrete structures 385
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 126, WTW 218 and WTW 285
Contact time: 1 dpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Combinations and permutations, ordinary and exponential generating functions, the principle of inclusion-exclusion, difference sequences, Stirling numbers, partitions, Burnside's theorem, Polya theory, counting of graphs.

WTW 386 Partial differential equations 386
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 218 and WTW 286
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 1
Language of tuition: Double Medium **Credits:** 18
Module content:
Conservation laws and modelling. Fourier analysis. Heat equation, wave equation and Laplace's equation. Solution methods including Fourier series. Energy and other qualitative methods.

WTW 387 Continuum mechanics 387
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 218 and WTW 286
Contact time: 2 lpw 1 tpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Kinematics of a continuum: Configurations, spatial and material description of motion. Conservation laws. Analysis of stress, strain and rate of deformation. Linear constitutive equations. Applications: Vibration of beams, equilibrium problems in elasticity and special cases of fluid motion.

WTW 389 Geometry 389
Academic organisation: Mathematics and Applied Mathematics
Prerequisite: WTW 211
Contact time: 1 tpw 2 lpw
Period of presentation: Semester 2
Language of tuition: Double Medium **Credits:** 18
Module content:
Axiomatic development of neutral, Euclidean and hyperbolic geometry. Using models of geometries to show that the parallel postulate is independent of the other postulates of Euclid

ZEN 161 Animal diversity 161
Academic organisation: Zoology and Entomology
Prerequisite: MLB 111 GS or TDH
Contact time: fortnightly practicals 2 lpw
Period of presentation: Semester 2
Language of tuition: Both Afr and Eng **Credits:** 8
Module content:
Animal classification, phylogeny, organization and terminology. Evolution of the various animal phyla, morphological characteristics and life cycles of parasitic and non-parasitic animals. Structure and function of reproductive, respiratory, excretory, circulatory and digestive systems.

ZEN 251 Invertebrate biology 251
Academic organisation: Zoology and Entomology
Prerequisite: ZEN 161 GS or TDH
Contact time: 4 lpw 1 ppw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 12
Module content:
Origin and extent of modern invertebrate diversity; parasites of man and domestic animals; biology and medical importance of arachnids; insect life styles; the influence of the environment on insect life histories; insect phytophagy, predation and parasitism; insect chemical, visual, and auditory communication; freshwater invertebrates and their use as biological indicators.

ZEN 261 African vertebrates 261
Academic organisation: Zoology and Entomology
Prerequisite: ZEN 161 GS or TDH
Contact time: 1 ppw 4 lpw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 12
Module content:
Introduction to general vertebrate diversity; African vertebrate diversity; vertebrate structure and function; vertebrate evolution; vertebrate relationships; aquatic vertebrates; terrestrial ectotherms; terrestrial endotherms; vertebrate characteristics; classification; structural adaptations; habits; habitats; conservation problems; impact of humans on other vertebrates.

ZEN 351 Population ecology 351
Academic organisation: Zoology and Entomology
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 18
Module content:
Scientific approach to ecology; evolution and ecology; the individual and its environment; population characteristics and demography; competition; predation; plant-herbivore interactions; regulation of populations; population manipulation.

ZEN 352 Mammalogy 352
Academic organisation: Zoology and Entomology
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 1
Language of tuition: English **Credits:** 18
Module content:
Mammalian origins and their characteristics: evolution of African mammals; structure and function: integument, support and movement; foods and feeding; environmental adaptations; reproduction; behaviour; ecology and biogeography; social behaviour; sexual selection; parental care and mating systems; community ecology; zoogeography. Special topics: parasites and diseases; domestication and domesticated mammals; conservation.

ZEN 353 Community ecology 353
Academic organisation: Zoology and Entomology
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 18
Module content:
The scientific approach; characteristics of the community; the community as a superorganism; community changes; competition as a factor determining community structure; disturbance as a determinant of community structure; community stability; macroecological patterns and mechanisms.

ZEN 354 Physiology 354
Academic organisation: Zoology and Entomology
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 2
Language of tuition: English **Credits:** 18
Module content:
The module in animal physiology is designed to promote understanding of animals as integrated systems at every level of organization. The module focuses on the function of tissues, organs and organ systems of multicellular organisms in chemical and physical terms. Animal physiology is the study of how a living animal functions. This module adopts a systems-based approach that covers many of the subdisciplines of physiology, ranging from neural physiology and endocrinology to mechanoreception and osmoregulation.

ZEN 355 Insect diversity 355
Academic organisation: Zoology and Entomology
Prerequisite: ZEN 251 GS or TDH
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 1

Language of tuition: English **Credits:** 18
Module content:
The extent and significance of insect diversity. Functional insect morphology. The basic principles of taxonomy and the classification of taxa within the Insecta. Insect orders and economically and ecologically important southern African insect families. Identification of insect orders and families using distinguishing characteristics. General biological and behavioural characteristics of each group. Grouping of insects into similar life-styles and habitats.

ZEN 361 Ecophysiology 361
Academic organisation: Zoology and Entomology
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 18
Module content:
The costs of living; factors affecting metabolic rate; limitations to the acquisition of energy and nutrients; the principles of nutritional ecology; problems associated with herbivorous diets; the effects of temperature on whole organism processes and the response of species to temperature variation; ectothermic and endothermic temperature regulation; animal responses to high and low temperatures; water balance physiology of insects and vertebrates; osmoregulation in aquatic and terrestrial environments; the importance of physiological ecology for understanding geographic variation in body size, range size, and abundance.

ZEN 362 Evolution and phylogeny 362
Academic organisation: Zoology and Entomology
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 3
Language of tuition: English **Credits:** 18
Module content:
Evolution as a process and pattern, prime movers in evolution: Selection, drift, general population genetics. Population differentiation, clines, subspecies and species, adaptation as a major force in evolution and the panglossian paradigm, molecular evolution. Phylogeography, phylogenetic reconstruction. Evolutionary biogeography. Adaptation, Darwin's formulation, proximate and ultimate causation, genetic and developmental constraints, optimality. Phenotypic models, the comparative method, convergent evolution. Evolution of complex biological systems, origin of life and sex, macro-evolution, punctuated equilibrium, human evolution. Levels of selection. Species concepts.

ZEN 363 Behavioural ecology 363
Academic organisation: Zoology and Entomology
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
The history of behavioural ecology. A causal, developmental, evolutionary and adaptive approach. Sensory systems and communication. Sexual selection, mate choice and sperm competition. Kin selection and group living. Special reference to social insects. The behavioural ecology of humans. Phylogenetic basis of behavioural analysis. The role of behavioural ecology in conservation planning.

ZEN 364 Conservation ecology 364
Academic organisation: Zoology and Entomology
Contact time: 2 ppw 4 lpw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
This module is intended to provide students with skills to undertake field surveys that are essential for research and planning in the conservation of biodiversity. The module has a large fieldwork component. A field trip will be conducted over a ten-day period during the September vacation in the Sani Pass region of the Drakensberg (including South Africa and Lesotho).
The students will be actively involved in planning and executing the field surveys, and will be responsible for analysing and presenting the results. The students will gain valuable practical experience in the field by applying a number of survey techniques and focusing on several different taxa that are relevant to conservation ecology.

ZEN 365 Insect pest management 365
Academic organisation: Zoology and Entomology
Contact time: 4 lpw 2 ppw
Period of presentation: Quarter 4
Language of tuition: English **Credits:** 18
Module content:
*It is strongly recommended that students first complete ZEN 355: Insect diversity 355

Definition, classification and characteristics of insect pests. Concepts of economic levels. Monitoring, surveys, sampling and forecasting. Yield loss assessment. Philosophy and context of integrated pest management. Alternative methods of pest control. Insecticide resistance and management. Important pests of South African agricultural crops, gardens and lawns.

Note:

Modules not listed in this publication can be accessed at: https://www.up.ac.za

E&OE